TWIN DISC
INCORPORATED

Service Manual

Marine Transmission

Components:
MGX-5135SC

Document Number: 1022127

NOTICE

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July, 2005

Marine Transmission Service Manual

TWIN DISC, INCORPORATED
EXCLUSIVE LIMITED WARRANTY
MARINE PLEASURE CRAFT TRANSMISSION

A. Twin Disc, Incorporated warrants all assembled products and parts, (except component products or parts on which written warranties issued by the respective manufacturers thereof are furnished to the original customer, as to which Twin Disc, Incorporated makes no warranty and assumes no liability) against defective materials or workmanship *for a period of thirty six (36) months from the date of original shipment by Twin Disc, Incorporated to the original customer, but not to exceed twenty four (24) months of service, whichever occurs first.* **This is the only warranty made by Twin Disc, Incorporated and is in lieu of any and all other warranties, express or implied, including the warranties of merchantability or fitness for a particular purpose and no other warranties are implied or intended to be given by Twin Disc, Incorporated. This warranty applies only to private, non commercial (non revenue earning) marine pleasure craft applications delivered by Twin Disc, Incorporated to the original customer on or after May 1, 1995.**

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B. **The exclusive remedy provided by Twin Disc, Incorporated whether arising out of warranty within the applicable warranty period as specified, or otherwise (including tort liability), shall at the sole option of Twin Disc, Incorporated be either the repair or replacement of any Twin Disc, Incorporated part or product found by Twin Disc, Incorporated to be defective. For all models except MG340 and MG360 this include the labor to perform that work and to remove and reinstall (or equivalent credit). In this context, labor is defined as the flat rate labor hours established by Twin Disc, Incorporated in the published Twin Disc Flat Rate Schedule, required to remove, disassemble, inspect, repair, reassemble, reinstall and test the Twin Disc, Incorporated product only. Authorized reasonable travel and living expenses will be considered for payment in all model except MG340 and MG360. Under no circumstances, including a failure of the exclusive remedy, shall Twin Disc, Incorporated be liable for economic loss, consequential, incidental or punitive damages.**.

The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to Twin Disc, Incorporated within sixty (60) days after completion of the in warranty repair.
2. The warranty is void if, in the opinion of Twin Disc, Incorporated, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.
3. The warranty is void if any modifications are made to any product or part without the prior written consent of Twin Disc, Incorporated.
4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by Twin Disc, Incorporated.
6. The warranty is void unless all required replacement parts or products are of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Replacement parts or products not of Twin Disc origin are not warranted by Twin Disc, Incorporated.

C. As consideration for this warranty, the original customer and subsequent purchaser agree to indemnify and hold Twin Disc, Incorporated harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer's and subsequent purchaser's employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only a Twin Disc, Incorporated authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by Twin Disc, Incorporated.

E. Twin Disc, Incorporated reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.

TWIN DISC, INCORPORATED
FLAT RATE HOUR ALLOWANCE
MARINE PLEASURE CRAFT TRANSMISSION

(Hourly Labor Rates Must Be Acceptable to Twin Disc, Incorporated)

MODEL SERIES	R&R	UNIT REBUILD
• MG340, MG360	0.0	0.0
• MG502, MG5005, MG5010, MG5011, MG5012, MG5015, MG5020	10.0	8.0
• MG506, MG5061, MG5061, MG5061, MG5062, MG5065, MG5050, MG5055	10.0	11.0
• MG507, MG5081, MG5085, MG5090 MG5075, MG5091	10.0	12.0
• MG5112, MG5113, MG5085, MG5091, MG5090, MG509, MG 5111, MG5114, MGX5114	10.0	17.0
• MG514C, MG514M, MG5141, MG514CHP MGX5135, MGX5145, MGX5147	10.0	25.0
• MG516, MG5161, MG5170	10.0	28.0
• MG518-1	10.0	32.0
• MG520-1, MG 5202, MG5203, MG5204, MG5205, MG6449, MG6557	10.0	32.0
• MG530, MG530M, MG5301,MG6650, MG6690, MG6848, MG6598, MG6600, MG6619, MG6620, MG6984, MG61242, MGX6650, MGX6690, MGX6848	12.0	32.0
• MGN80, MGN232, MGN233, MGN272, MGN273, MGN332, MGN334, MGN335, MGN432, MGN433, MGN472, MGN493	10.0	32.0
• MGN650, MGN800, MGN1000, MGN1400, MGN1600	20.0	62.0
• PUMP (ALL MODELS EXCEPT MG340 & MG360)	1.0	-
• VALVE (ALL MODELS EXCEPT MG340 & MG360)	1.0	.5

Table of Contents

Introduction 11
- General Information 11
- Safety and General Precautions 11
- Preventative Maintenance 13
- Towing 13
- Ordering Parts and Obtaining Services 14
- Source of Service Information 15
- Warranty 15

Description and Specifications 17
- General 17
- Power Ratings 19
- Changing Rotation 19
- Direction of Drive 19
- Construction Features 20
- Lubrication Features 21
- Heat Exchanger 23
- Specifications and Maintenance 25
- Oil Pressures 27
- Optional Equipment 28
- Torque Values for Fasteners 31
- Clutch Plate Wear Limits 34

Operation 35
- General 35
- General Overview of GP Control Valve with Electronic Interface 36
- Hydraulic System with GP Control Valve 43
- Power Take-off (Optional) 47
- Power Flow 48

Preventative Maintenance 53
- In-boat Maintenance and Repair 53
- General Maintenance 54
- Periodic Visual Inspection 56

Troubleshooting 59
Troubleshooting of Electric Control Valve 59
Pressure Test Kit 60
Troubleshooting of GP Control Valve with Electronic Interface . 61

Disassembly 65
Prepare Transmission for Disassembly 65
Prior to Removal 67
Remove External Parts 68
Remove Internal Parts 77
Remove Output Gear and Shaft 88
Primary Clutch Shaft Disassembly 95
Secondary Clutch Shaft Disassembly 100
Disassembly of GP Control Valve with Electronic Interface 105
Disassembly 106

Cleaning and Inspection 113
Cleaning 113
Inspection 115

Assembly 119
General 119
Prior to Assembly - Output End Bearings 121
Primary Shaft Assembly 122
Secondary Shaft Assembly 127
Main Housing Assembly 132
Output Gear and Output Shaft Assembly 133
Bearing Preload Measurement and Shimming 141
Rear Bearing Cups 144
Install External Components 154
Assembly of GP Control Valve with Electronic Interface 162
Adjustment of Main Pressure 166

Installation 169
Prior to Installation 169
Alignment (also reference SAE J-1033 and J-617) 170
Alignment 173
Electrical Controls Installation 179
Wiring Connections 181

Special Tools 185

List of Special Tools 185
Recommended Pump Set and Fluids 186
Release Spring Compressor 188
Special Bearing Races 189
Front Outer Bearing Race Installation Tool 190
Inner Bearing Race Installation Tool 191
Rear Outer Bearing Installation Tool 192
Seal Installation Tool 193
End-Play Bracket 194
Output Gear Advance Tool 195
1020117 - “S” Valve Test Body 196
B2408AL “S” Valve Test Procedure 197

Engineering Drawings 199

List of Engineering Drawings 199

NOTES

Introduction

General Information

This publication provides service information for the Twin Disc MGX-5135SC marine transmission. Specific engineering details and performance characteristics can be obtained from the Product Service Department of Twin Disc, Incorporated, Racine, Wisconsin, USA.

Operation and maintenance personnel responsible for this equipment should be familiar with this publication and have it at their disposal. A thorough understanding and application of the material in this manual will result in consistent performance from the unit and help reduce downtime.

Safety and General Precautions

General

All personnel servicing this equipment should employ safe operating practices. Twin Disc, Inc. will not be responsible for personal injury resulting from careless use of hand tools, lifting equipment, power tools, or unacceptable maintenance/ working practices.

Important Safety Notice

Proper installation, maintenance, and operation procedures must be followed due to the possible danger to person(s) or property from accidents that may result from the use of machinery. Twin Disc, Inc. will not be responsible for personal injury resulting from careless maintenance/working practices.

Inspect as necessary to assure safe operations under prevailing conditions. Proper guards and other safety devices that may be specified in safety codes should be provided. These devices are neither provided by, nor are they the responsibility of Twin Disc, Inc.

⚠ WARNING

Selecting NEUTRAL disengages transmission clutches but does not prevent propeller shaft rotation. If you require positive neutral (propeller shaft locked), a shaft brake or other shaft-locking device must be used.

⚠ WARNING

To prevent accidental starting of the engine when performing routine transmission maintenance, disconnect the battery cables from the battery and remove ignition key from the switch.

⚠ WARNING

Most Twin Disc products have provisions for attaching lifting bolts. The holes provided are always of adequate size and number to safely lift the Twin Disc product. These lifting points must not be used to lift the complete power unit. Lifting excessive loads at these points could cause failure at the lift point (or points) and result in damage or personal injury.

⚠ CAUTION

Select lifting eyebolts to obtain maximum thread engagement with bolt shoulder tight against housing. Bolts should be near but should not contact bottom of bolt hole.

Preventative Maintenance

Frequent reference to the information provided in the Marine Transmission Owner's Manual, 1016313, regarding daily operation and limitations of this equipment will assist in obtaining trouble-free operation. Schedules are provided for recommended maintenance of the equipment.

Towing

⚠ WARNING

Under the conditiions described below, the prop shaft must be locked in place to prevent backdriving. Failure to do this can damage the marine transmission due to lack of component lubrication

Backdriving (also called windmilling) occurs when an engine is shut down and the propeller shaft is being driven by the flow of water across the propeller, which, in turn, rotates the components in the marine transmission. During backdriving conditions, the transmission does not receive proper lubrication.

Conditions where backdriving may occur:

- ❑ Vessel is being towed.
- ❑ One or more engines on a multiple-transmission vessel are shut down while under way.
- ❑ Sailboat under sail with auxiliary engine shut down.
- ❑ Vessel tied up or docked in a heavy current.

Any of the following solutions are applicable if any of the above conditions are present:

- ❑ Lock the propeller shaft to prevent rotation.
- ❑ Add an optional trailing oil pump into the lubrication circuit.

Refer to the hydraulic system schematics for more details on the optional trailing pump specifications for the applicable transmission, or contact your Twin Disc Authorized Distributor.

Ordering Parts and Obtaining Services

⚠ WARNING

All replacement parts or products (including hoses and fittings) must be of Twin Disc origin or equal, and otherwise identical with components of the original equipment. Use of any other parts or products will void the warranty and may result in malfunction or accident, causing injury to personnel and/or serious damage to the equipment.

Ordering Service Parts

Renewal parts, service parts kits, optional equipment and product service assistance may be obtained from any authorized Twin Disc distributor or service dealer. Contact Twin Disc for the distributor or service dealer near you.

Note: Do not order parts using the part numbers on the cross-sectional drawings. These numbers may be referenced for part identification; however, they should be verified on the bill of material (BOM) before an order is placed. BOM numbers are stamped on the unit nameplate.

Twin Disc, having stipulated the bill of material number on the unit's nameplate, absolves itself of any responsibility resulting from any external, internal, or installation changes made in the field without the express written approval of Twin Disc. All returned parts, new or old, resulting from any of the above stated changes will not be accepted for credit. Furthermore, any equipment that has been subjected to such changes will not be covered by a Twin Disc warranty.

Source of Service Information

For the latest service information on Twin Disc products, contact any Twin Disc distributor or service dealer. This can be done on the Twin Disc corporate web site found at [http://www.twindisc.com]. Provide your model number, serial number and bill of material number to obtain information on your unit. If necessary, contact the Product Service Department, Twin Disc, Incorporated, Racine, Wisconsin 53405-3698, USA by e-mail at service@twindisc.com.

Warranty

Equipment for which this manual was written has a limited warranty. For details of the warranty, refer to the warranty statement at the front of this manual. For details of the warranty, contact any Twin Disc Authorized Distributor, service dealer, or the Warranty Administration Department, Twin Disc, Inc., Racine, Wisconsin, U.S.A.

NOTES

Description and Specifications

General

The MGX-5135SC is a reverse and reduction transmission with the additional Quickshift™ feature. The output shaft is parallel ot the input shaft. The MGX-5135SC offers conical gearing for quieter operation and is available in the rollowing ratios: 1.00:1, 1:10:1, 1.28:1, 1.48:1, 1.73:1, 2.04:1, 2.57:1, and 2.90:1.

The MGX-5135SC transmission is controlled by hydraulics. Both the primary and secondary clutches are operated by main pressure oil supply. The bearings, clutches and gears are lubricated and cooled with low pressure oil.

Drawing PX-11840 identifies the installation information for the MXG-5135SC marine transmission.

Nameplate

The nameplate identifies the model, bill of material (BOM) and the serial number of the unit. These numbers are necessary to identify the correct parts for your transmission.

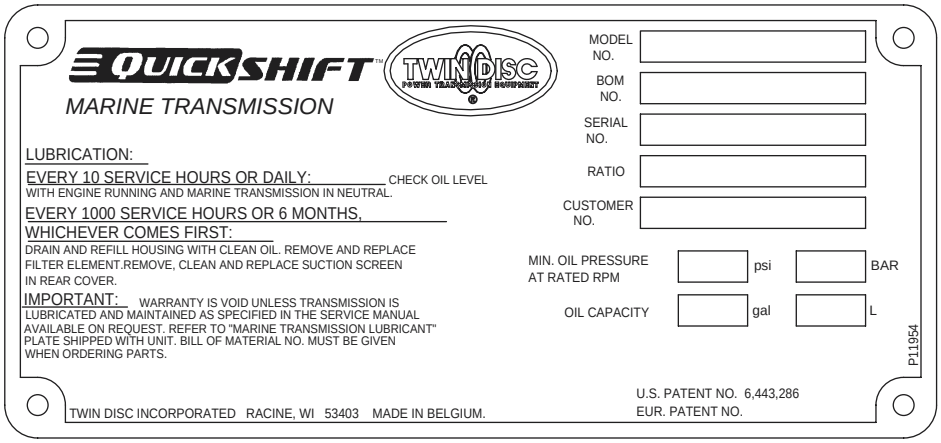
QUICKSHIFT
MARINE TRANSMISSION
TWIN DISC
LUBRICATION:
EVERY 10 SERVICE HOURS OR DAILY: CHECK OIL LEVEL
WITH ENGINE RUNNING AND MARINE TRANSMISSION IN NEUTRAL.
EVERY 1000 SERVICE HOURS OR 6 MONTHS,
WHICHEVER COMES FIRST:
DRAIN AND REFILL HOUSING WITH CLEAN OIL. REMOVE AND REPLACE FILTER ELEMENT.REMOVE, CLEAN AND REPLACE SUCTION SCREEN IN REAR COVER.
IMPORTANT: WARRANTY IS VOID UNLESS TRANSMISSION IS LUBRICATED AND MAINTAINED AS SPECIFIED IN THE SERVICE MANUAL AVAILABLE ON REQUEST. REFER TO "MARINE TRANSMISSION LUBRICANT" PLATE SHIPPED WITH UNIT. BILL OF MATERIAL NO. MUST BE GIVEN WHEN ORDERING PARTS.
MODEL NO.
BOM NO.
SERIAL NO.
RATIO
CUSTOMER NO.
MIN. OIL PRESSURE AT RATED RPM
psi
BAR
OIL CAPACITY
gal
L
P11954
TWIN DISC INCORPORATED RACINE, WI 53403 MADE IN BELGIUM.
U.S. PATENT NO. 6,443,286
EUR. PATENT NO.
P11954

Figure 1. Example of MGX-5135SC Nameplate

Power Ratings

The MGX-5135SC transmission can be operated through either the primary shaft or secondary shaft at its full rated horsepower when driven by a standard right hand rotation engine (counterclockwise flywheel rotation direction when viewing rear of engine).

Always reference the Bill of Materials (BOM) or Specification number when ordering service parts.

Changing Rotation

When shipped form the factory, each unit is designated for use with a particular engine rotation. Within their rated capacities, these units may be operated continuously in either forward or reverse.

The unit can be adapted to either left or right-hand engine rotation. To adapt to opposite engine rotation, remove the heat exchanger hose from the rear end of the pump. Remove the pump, turn it 180° and reinstall it. Remove the plug from the rear of the pump and install where the heat exchanger hose was. Install the heat exchanger hose where the plug was. When changing from RH rotation to LH rotation install an engine rotation plate (Arrow) to indicate the new direction of rotation.

Direction of Drive

The primary (input) clutch shaft and driving transfer gear always rotates in engine direction. The secondary clutch shaft and driven transfer gear always rotate in anti-engine direction because the driven transfer gear is meshed with the driving transfer gear on the primary clutch shaft. When the primary clutch is engaged, the primary input pinion rotates in engine direction. The output gear, which is secured to the output shaft, is meshed with the primary input pinion and so the output gear and shaft are driven in anti-engine direction. When the secondary clutch is engaged, the secondary input pinion rotates in anti-engine direction. The output gear is meshed with the secondary input pinion and, therefore, the output gear and shaft are driven in engine direction.

Construction Features

Housings

The MGX-5135SC transmission has a one piece main housing with a bolt on SAE #1 or SAE #0 engine housing adapter. A manifold and a top cover, sealed with gaskets, bolts onto the housing. An end cover is located on the primary shaft and a pump located on the secondary shaft completes the housing enclosure.

Taper Roller Bearings

The primary and secondary clutch shafts are supported and located by tapered roller bearings. The pinions are supported on bushings and the end movement limited by thrust washers. Bearing clearances for each clutch shaft are set by use of a single shim pack at the rear-tapered roller bearing on each shaft. Tapered roller bearings support the output shaft and have bearing clearance adjusted by use of shims.

Oil Pump Drive

The oil pump is tang-connected and driven by the secondary clutch shaft.

Lubrication Features

The MGX-5135SC transmission bearings and clutches on the primary and secondary shafts are lubricated through oil passages drilled in the shafts. The output shaft bearing, transfer gears, primary and secondary pinions and their bearings are gravity and splash lubricated.

Suction Strainer

The marine transmission has a serviceable suction strainer located below the oil pump. The strainer is between the sump and the oil pump in the hydraulic circuit. The strainer can be replaced if necessary.

Oil Filter Assembly

A spin-on oil filter is a standard feature on MGX-5135SC transmissions. The filter is located between the heat exchanger outlet and the selector valve in the hydraulic circuit. The replacement element should be replaced at 1000 hours or six-month intervals, whichever comes first. The replacement filter part number is PM11652.

Gears

All gears are helical, carburized, hardened and ground for smooth quiet operation. All gears are in constant mesh. The primary and secondary transfer gears and the output gear are mounted on keyless tapers.

Flexible Torsional Input Coupling

The purpose of the torsional coupling is to transmit power from the engine to the marine transmission through a rubber or silicone element that will:

- ❑ Dampen torsional vibrations
- ❑ Change the natural frequencies of a system to move critical frequencies out of the operating speed range
- ❑ Accommodate a certain amount of misalignment
- ❑ Absorb shock and reduce noise
- ❑ Minimize gear “rattle”

Several couplings are available from Twin Disc, and are selected based on the customer supplied engine information. Final coupling selection must be confirmed by the packager based on the torque/rpm ratings and the results of the system torsional vibration analysis (TVA), and on engine rotation. Care must be taken when servicing that replacement couplings are matched to this criteria.

Heat Exchanger

The heat exchanger is designed to maintain the oil in the hydraulic system of the marine transmission at the proper temperature by passing coolant from the engine through the heat exchanger. The heat exchanger is mounted on a special bracket bolted on the live PTO face. The special brackets allow either live PTO connection or clutchable PTO and no PTO as well. In case of remote mounting, the heat exchanger should be installed in a location convenient to both engine coolant and marine transmission oil.

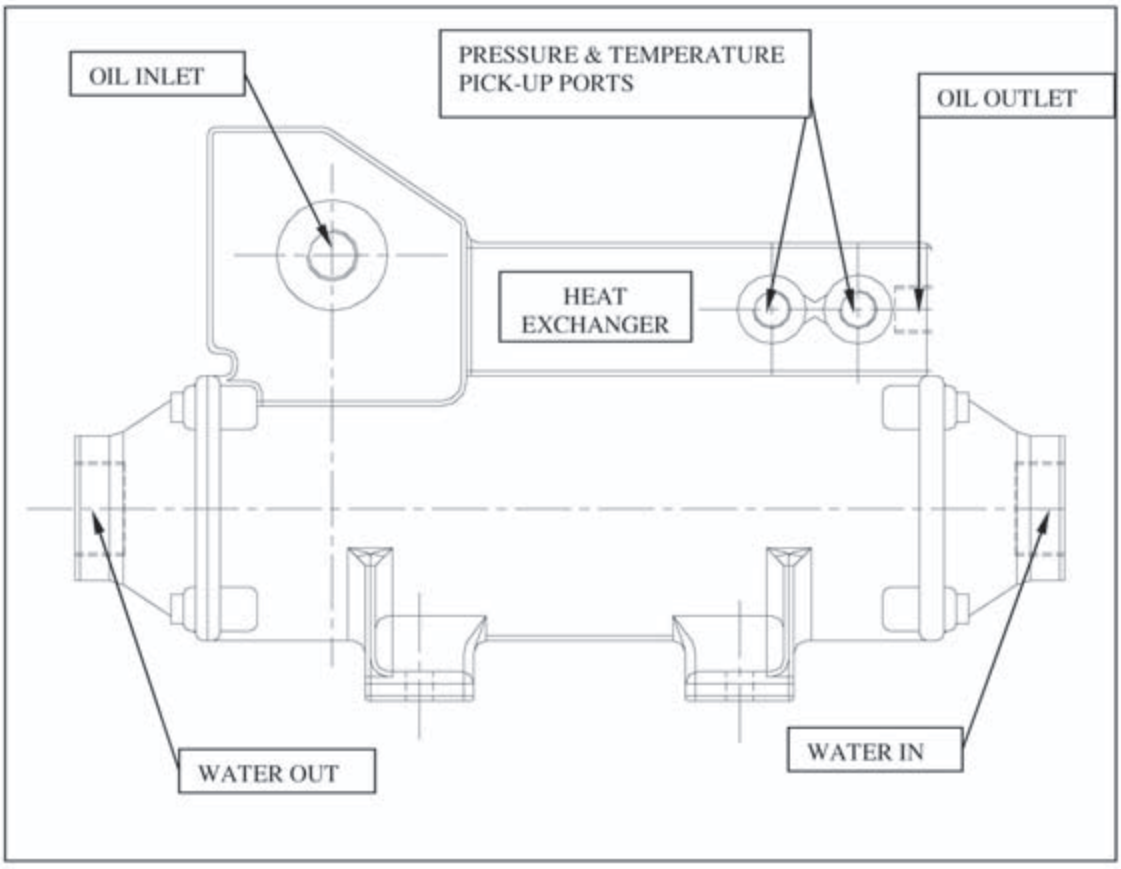

Figure 2. Heat Exchanger

Table 1. Heat Exchanger Requirements

HEAT EXCHANGER (H.E.) REQUIREMENTS			
PERMISSIBLE OIL TEMPERATURE INTO HEAT EXCHANGER			
RATIO	OIL VISCOSITY	MAX.	MIN.
ALL RATIOS	SAE 30	85˚C(185˚F)	65˚C(150˚F)
ALL RATIOS	SAE 40	99˚C(210˚F)	80˚C(175˚F)

MIN. HEAT TRANSFER CAPACITY (APPLY APPROPRIATE SERVICE FACTOR FOR FRESH AND RAW WATER)	KW(BTU/MIN) PER ENGINE RTD. H.P.	
	CONTINUOUS DUTY	P.C. & INT. DUTY
	.026(1.484)	.022(1.272)
APPROX. OIL FLOW TO H.E.	2.3 L/MIN(.61 GPM) PER 100 ENGINE R.P.M.	
PEAK OIL PRESSURE AT H.E. (PROOF TEST H.E. AT 1,5 X KPa(PSI)	1965 KPa(285 PSI)	
MAX. ALLOWABLE OIL PRESSURE DROP ACROSS H.E. WITH 66mm ^{2}/sec (300 SUS) OIL AT RATED ENGINE R.P.M	207 KPa (30 PSI)	
WATER FLOW TO H.E. - USE 1.5 TO 3.0 TIMES OIL - L/MIN.(GPM)		
H.E. WATER PRESSURE RATING, MIN., = 1.5 X H.E. INLET WATER KPa(PSI)		

DATA H.E. PURCHASER MUST ALSO TELL VENDOR
STATE IF RAW (OPEN CHANNEL & SEA) OR FRESH (CLOSED ENGINE JACKET * AND/OR KEEL COOLER) WATER WILL COOL H.E.
STATE MAX. WATER TEMP. INTO H.E. -- TYPICAL: RAW WATER - 29˚C-32˚C (85˚F-90˚F), KEEL COOLER WATER 46˚C-60˚C(115˚F-140˚F), ENGINE JACKET WATER* 74˚C-85˚C(165˚F-185˚F).
STATE MIN., ALSO MAX. L/MIN. (GPM) OF WATER FLOW TO H.E.

H.E. INSTALLATION & SERVICE REQUIREMENTS
OIL LINES, TRANSMISSION TO H.E. AND RETURN ----
(1) MAX. VELOCITY IN FITTINGS,PIPE,HOSE AND TUBES-7,6m/sec (25FT./SEC.)
(2) BURST PRESSURE, MIN., = 10 x PEAK OIL PRESSURE AT H.E.
(3) HOSE - SAE J517 100R1 MEETING USCG 46CFR 56.60-25(C),135˚C (275˚F) TEMP. RATING
(4) PROTECT LINES FROM MECHANICAL DAMAGE. ZINC ANODES PROTECT H.E. RAW WATER PASSAGES FROM CORROSION. CHECK & REPLACE THEM FREQUENTLY.

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Specifications and Maintenance

Frequent reference to this data and application of the information will result in better service from the transmission.

Oil Capacity

15.1 Liters (4.0 US Gal.) less hoses and heat exchanger.
The transmission should be warmed to operating temperature when oil is checked.

Oil Pump Capacity

14.1 GPM @ 1800 RPM.

Minimum Oil Pressure When Cruising

Check your unit's identification plate. MGX-5135SC has a minimum oil pressure at rated engine RPM, located on the name plate, of 1860 kPa (270 psi) non trolling mode.

Maximum Input Speed

2500 RPM.

Dry Weight

Approximately 300 Kg (661 lbs).

Type of Oil and Oil Viscosity

Note: Multi-viscosity oils (i.e. 10W-20 etc.) should not be used in Twin Disc MarineTransmissions.

The recommended oil is mentioned on the lubricant nameplate located on the housing of your Marine Gear.

Table 2. Marine Transmission Lubricant

MARINE TRANSMISSION LUBRICANT

OIL SERVICE CLASS- USE S.A.E. -API SERVICE CLASS CD ENGINE OIL CERTIFIED BY VENDOR TO PASS TO-2 OIL TEST. ALSO APPROVED ARE S.A.E.-API SERVICE CLASS CC ENGINE OIL, MIL-L-2104B, AND TRANSMISSION FLUID TYPE C-3.

VISCOSITY- BASE SELECTION ON SUMP OIL TEMP. CONDITIONS TABULATED BELOW.

START-UP	STEADY OPERATION	VISCOSITY
32 F MIN. (0 C MIN.)	150 -150 F (65 -85 C)	S.A.E. NO. 30
32 F MIN. (0 C MIN.)	175 -210 F (80 -99 C)	S.A.E. NO. 40

STEADY OPERATION BELOW 150 F (65 C) OR ABOVE 210 F (99 C) IS NOT RECOMMENDED.

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RACINE, WI. 65403 U.S.A.

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Oil Pressures

The following tables give oil pressures at different speeds and ranges. Check your unit's identification plate for the "Minimum Oil Pressure When Cruising". Use this value to determine which table applies to your unit. See MGX-5135SC rear view for location of oil pressure checkpoints.

Table 3. 2414 kPa (350 psi) Transmission Oil Pressure Specifications

Limits for Marine Transmission Equipped with 2414 kPa (350 psi) Proportional Valves									
Input Speed	Shift Position	Main Pressure at Valve Inlet		Primary Clutch Min.		Secondary Clutch Min.		Lube	
		kPa	psi	kPa	psi	kPa	psi	kPa	psi
600	Neutral	1759-1897	255-275	0	0	0	0	21-69	3-10
600	Primary	1759-1897	255-275	1724	250	0	0	14-55	2-8
600	Secondary	1759-1897	255-275	0	0	1724	250	14-55	2-8
1800	Neutral	1862-2000	270-290	0	0	0	0	124-276	18-40
1800	Primary	1862-2000	270-290	1828	265	0	0	124-241	18-35
1800	Secondary	1862-2000	270-290	0	0	1828	265	124-241	18-35

Note: Cooling temperature range: Delvac 1110 oil at 29-35°C (85-95°F) or Mobilkote 501 at 32-38°C (90-100°F).

Required: Primary lube pressure = secondary lube pressure within 21 kPa (3 psi).

Primary and secondary clutches must be within 21 kPa (3 psi) of each other.

ALL SHIFTS MUST BE DONE AT OR BELOW 1800 RPM.

Table 4. Limits for Marine Transmission Equipped with Hydraulic Clutched PTO

Limits for Marine Transmission Equipped with Hydraulic Clutched PTO									
Input rpm	PTO Control Valve Disengaged		Actual		PTO Control Valve Engaged		Actual		
	kPa	psi	kPa	psi	kPa	psi	kPa	psi	
600	0	0			1793-1931	260-280			Transmission Control Valve Engaged
1800	0	0			1896-2000	275-290			
600	0	0			1759-1862	255-270			Transmission Control Valve Disengaged
1800	0	0			1827-1966	265-285			

Note: Transmission control valve is the right valve and the PTO valve is the left valve, when viewed the rear of the transmission.

Optional Equipment

The following optional equipment is available for the MGX-5135SC marine transmission (except where noted) through the nearest authorized Twin Disc distributor.

Power Take-off

A live pump-mount power take-off is available in sizes SAE J-744 No. 127-4 and SAE J-744 No. 32-4 (SAE “C”, 4-bolt).

A clutchable pump mount power take-off is available in sizes SAE J-744 No. 127-4 and SAE J744 No. 32-4.

A clutchable shaft drive power take-off is available.

PTO adapter from SAE J-744 size 127-4 to 101-4 (SAE “C” to SAE “B”).

Mounting Brackets

Steel fabricated mounting brackets for rigid mounting are available.

Torsional Input Coupling

Several models of torsional input couplings are available, including Silicon Vulkan (VKE) and Centa (CF-R).

Heat Exchanger

A heat exchanger is available, shipped loose or mounted.

Companion Flange Assembly

The companion flange assembly consists of the companion flange and mounting hardware.

Trolling Valve

An electronic E-troll module is available.

Table 5. Bearing Preload Specifications

Transmission Primary and Secondary Shaft Tapered Roller Bearing Preload		
Assembly No.	**Minimum**	**Maximum**
All	0.00 mm (0.000 in.)	+0.05 mm (+0.002 in.)
Transmission Ouptut Shaft Bearing Preload		
Assembly No.	Minimum	Maximum
All	+0.13 mm (+0.005 in.)	+0.18 mm (+0.007 in.)

Note: A negative endplay indicates a pre-load condition.

Table 6. Maximum Allowable Total Indicator Runout

Feature	Maximum Allowable Total Indicator Reading
Face of SAE #0 cover adapter from input spline	0.30 mm (0.012 in.)
Face of SAE #1 cover adapter from input spline	0.25 mm (0.010 in.)
Pilot of SAE #0, SAE #1 cover adapter from input spline	0.20 mm (0.008 in.)
Face of output flange near OD from housing	0.10 mm (0.004 in.)
Pilot of output flange from housing	0.10 mm (0.004 in.)

Table 7. Ouput Gear Advance

Minimum	Actual	Maximum
3.81 mm (0.150 in.)		5.33 mm (0.210 in.)

Table 8. Transfer Gear Advance

Shaft	Minimum	Actual	Maximum
Primary	5.33 mm (0.210 in.)		6.86 mm (0.270 in.)
Secondary	5.33 mm (0.210 in.)		6.86 mm (0.270 in.)

Table 9. Clutch Pack Clearance

Clutch Pack Endplay			
Shaft	**Minimum**	**Actual**	**Maximum**
Primary	2.30 mm (0.019 in.)		3.20 mm (0.126 in.)
Secondary	2.30 mm (0.019 in.)		3.20 mm (0.126 in.)

Table 10. Sequence Valve Adjustment

Sequence Valve Adjustment			
Shaft	**Minimum**	**Actual**	**Maximum**
Primary	1379 kPa (200 psi)		1517 kPa (220 psi)
Secondary	1379 kPa (200 psi)		1517 kPa (220 psi)

Torque Values for Fasteners

Note: Lubricate all threads and bearing face with light oil film prior to assembly.

Note: Use grade 5 and Property Class 8.8 specs when threading into aluminum.

Table 11. Metric Coarse Thread Capscrews, Bolts, and Nuts

Thread Size	Property Class 8.8		Property Class 10.9		Property Class 12.9	
	lb•ft	N•m	lb•ft	N•m	lb•ft	N•m
M6	6.5 - 7.5	9-10	9 - 10	12 - 14	10 - 12	14 - 16
M8	16 - 18	21 - 25	23 - 26	31 - 35	25 - 29	34 - 40
M10	32 - 36	43 - 49	44 - 51	60 - 68	51 - 59	70 - 80
M12	55 - 63	74 - 86	77 - 88	104 - 120	89 - 103	121 - 139
M16	132 - 151	179 - 205	189 - 217	256 - 294	219 - 253	298 - 342
M20	257 - 295	348 - 400	364 - 418	493 - 567	429 - 493	581 - 669
M24	445 - 511	603 - 693	626 - 720	848 - 976	737 - 848	1000 - 1150
M30	714 - 820	987 - 1113	1235 - 1421	1674 - 1926	1475 - 1697	2000 - 2301

Table 12. Metric Stainless Steel Capscrews, Bolts, and Nuts

Note: The use of nickel anti-seize compound is required to prevent corrosion due to galvanic action. Apply nickel anti-seize compound to the threads of these stainless steel fasteners before torquing to specification. See Standard Sheet S574B for a more complete listing of stainless steel fastener torque values.

Metric Coarse Thread Stainless Steel Capscrews, Bolts and Nuts	
Thread Size	Recommended Torque N•M (lb•ft)
M8	12 (8.5)
M10	24 (18)
M12	40 (30)
M14	63 (46)
M16	97 (72)

Table 13. Straight Threaded Tube Fittings, Hose Fittings, and O-ring Plugs

Nominal Thread Diameter	Nm + or - 5%	lb•ft + or - 5%	Nominal Thread Diameter	Nm + or - 5%	lb•ft + or - 5%
5/16	5	3.5	1 5/8	108	80
3/8	11.5	8.5	1 7/8	108	80
7/16	16	12	2 1/2	108	80
1/2	20	15	M10x1.0	12	9
9/16	24	18	M12X1.5	16	12
5/8	24	18	M14X1.5	20	15
11/16	34	25	M16X1.5	24	18
7/8	54	40	M18X1.5	34	25
1 1/16	75	55	M22X1.5	54	40
1 3/16	88	65	M27X2.0	75	55
1 1/4	88	65	M33X2.0	88	65
1 5/16	108	80	M42X2.0	108	80
1 3/8	108	80	M48X2.0	108	80

Table 14. Tapered Pipe Plugs (with thread lubricant)

Torque Values for Lubricated Pipe Plugs Recommended Torque in N•m (lb•ft)			
PT Size	**NPTF Size**	**Installed in Cast Iron or Steel**	**Installed in Aluminum**
1/16 - 28	1/16 - 27	11.5 ± 1.3 (8.5 ± 1.0)	7.5 ± 0.9 (5.5 ± 0.7)
1/8 - 28	1/8 - 27	14.2 ± 1.8 (10.5 ± 1.3)	8.8 ± 1.1 (6.5 ± 0.8)
1/4 - 19	1/4 - 18	34 ± 4 (25 ± 3)	22 ± 3 (16 ± 2)
3//8 - 19	3/8 - 18	37 ± 4 (27 ± 3)	23 ± 3 (17 ± 2)
1/2 - 14	1/2 - 14	68 ± 8 (50 ± 6)	41 ± 5 (30 ± 4)
3/4 - 14	3/4 - 14	73 ± 10 (54 ± 7)	46 ± 5 (34 ± 4)
1 -11	1 - 1-1/2	109 ± 13 (80 ± 10)	68 ± 8 (50 ± 6)
1-1/4 - 11	1-1/4 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)
1-1/2 - 11	1-1/2 - 11-1/2	115 ± 13 (85 ± 10)	75 ± 9 (55 ± 7)

Note: The lubricant is to be John Crane insoluble plastic lead seal No. 2 (or equivalent) or Loctite® No. 92 (or equivalent) and plugs are to be capable of removal with out damage. Overtightening may cause initial leakage plus potential removal damage.

An option of a maximum of two full turns after finger tightening the plug may be used if required and if removal conditions are met.

Table 15. Tubing Nuts

Torque Values for Tubing Nuts	
Nominal Tube Size	**Recommended Torque N•m (lb•ft)**
8 mm	39 (29)
10 mm	52 (38)
12 mm	62 (46)
15 mm	103 (76)
21.7 mm	118 (87)

Table 16. Banjo Fittings & Sealing Plugs with Copper Washers

Torque Values for Banjo Fittings & Sealing Plugs with Copper Washers	
Thread Size	**Recommended Torque N•m (lb•ft)**
M14X1.5	64 (47)
M16X1.5	83 (61)
M24X1.5	186 (137)

Clutch Plate Wear Limits

Clutch steel plates:

Minimum thickness: 2.34 mm (0.092 in.)

Clutch friction plates:

Minimum thickness: 3.07 mm (0.121 in.)

Operation

General

The GP Control Valve with its Electronic Interface is used to obtain neutral and primary clutch engagement and secondary clutch engagement in this transmission. When these positions are selected, the control valve directs high-pressure oil through internal passages to instantaneously and smoothly engage the clutches. The pressure-rate of rise, controlled by the Profile Generator, provides a rapid, smooth, clutch engagement.

General Overview of GP Control Valve with Electronic Interface

The General Purpose (GP) control valve is a hydraulic valve assembly for use with Twin Disc Marine Transmissions, that may include an integral electronic interface control module. The valve assembly contains current controlled proportional cartridges.

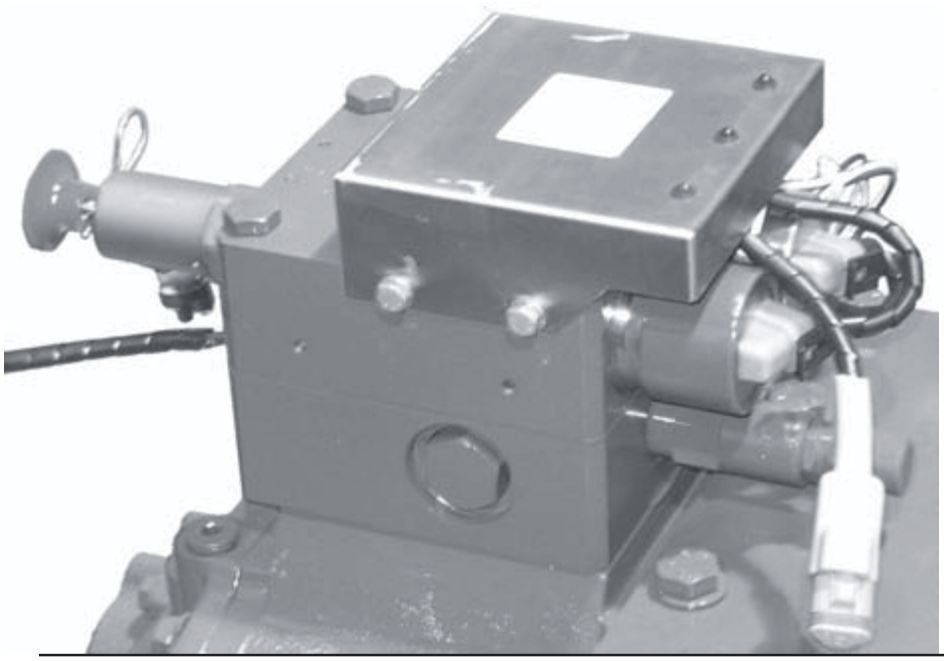


Figure 3. GP Valve Assembly mounted on Marine Transmission.

GP Control Valve Hydraulic Portion

The hydraulic portion of the GP Control Valve is made up of two blocks, a lower main regulator valve body, and an upper valve body. The upper valve body contains two electrically actuated proportional valves, and a manual direction control cartridge valve. The lower valve body contains the hydraulic pressure regulating valve and a temperature sensor if the application requires it. There are two different versions of the lower valve assembly. The hydraulic pressure regulating valve in earlier versions (Assembly 1020729) consist of two cartridge assemblies, a pilot relief cartridge assembly and a main spool cartridge assembly. The hydraulic pressure regulating valve in later versions (Assembly 1021658) is not a cartridge assembly, but is comprised of a spring and spool, with an adjustment cover. The regulating valve body contains a ball check valve assembly in parallel with an orifice with a filter that provides rapid fill and damping for the rear cavity of the regulator valve. A kit is available to upgrade the earlier version to the later version. The manual direction control cartridge valve contains a switch that is closed when the valve is in the neutral position. Separate identical proportional cartridges are used for the primary and secondary clutch actuation. When the primary or secondary clutch is selected by the operator, the control valve directs high-pressure oil through internal passages to operate the clutches. The pressure-rate of rise (profile) is controlled electronically by the GP Control Valve Electronic Interface (Profile or E-Troll Module) to provide a rapid, smooth, oil pressure increase in the clutch hydraulic passages during engagement.

⚠ CAUTION

The proportional valve coils are low resistance devices that are current driven. The use of an uncontrolled power source may supply too much current and damage the proportional valve.

Note: Installations with this valve must include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better. Besides the valve's requirement on filtration, the filter must meet the requirements of the transmission (operating pressure, flow, etc.)

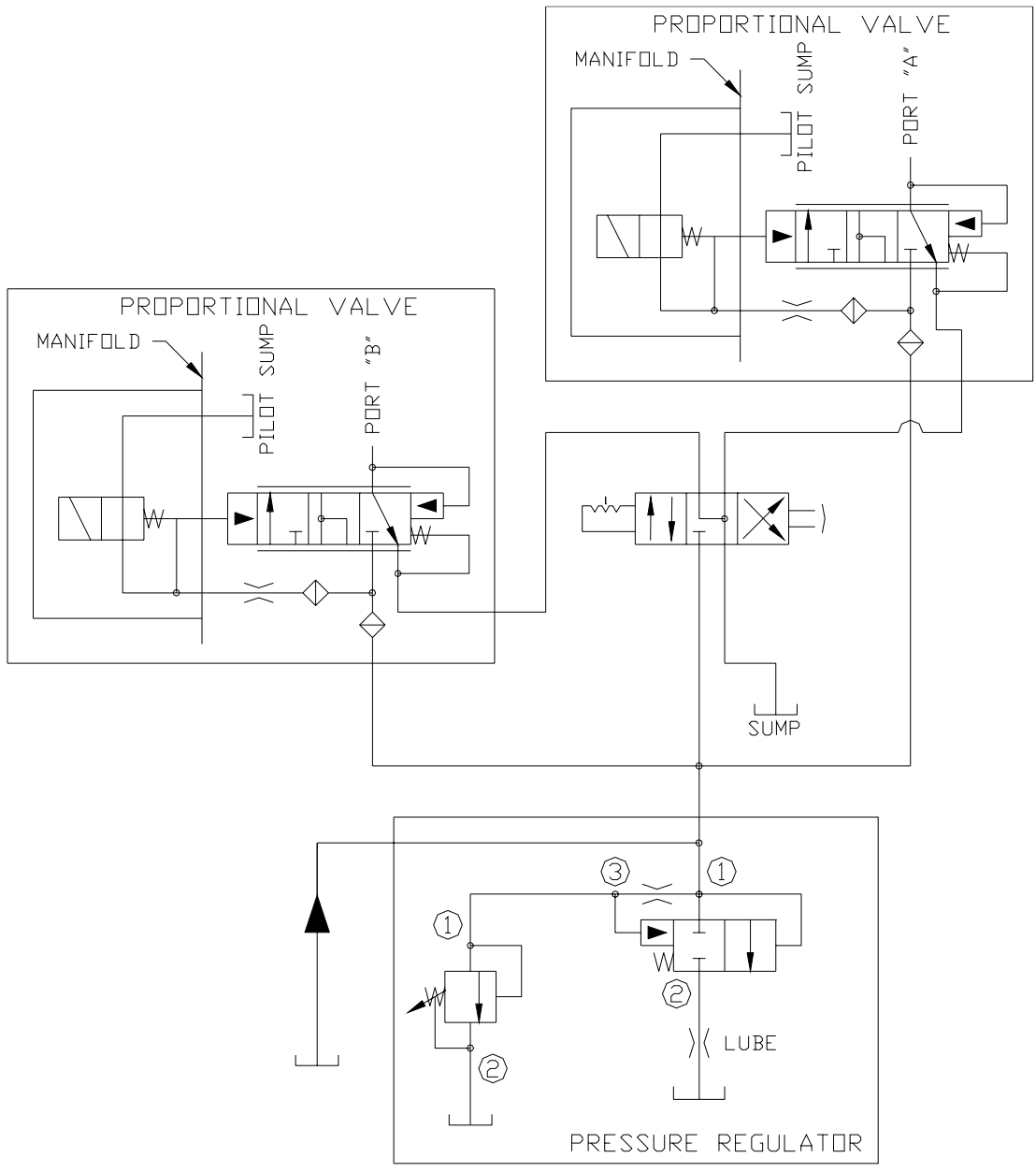


Figure 4. Hydraulic Schematic (GP control valve)- Assembly 1020729

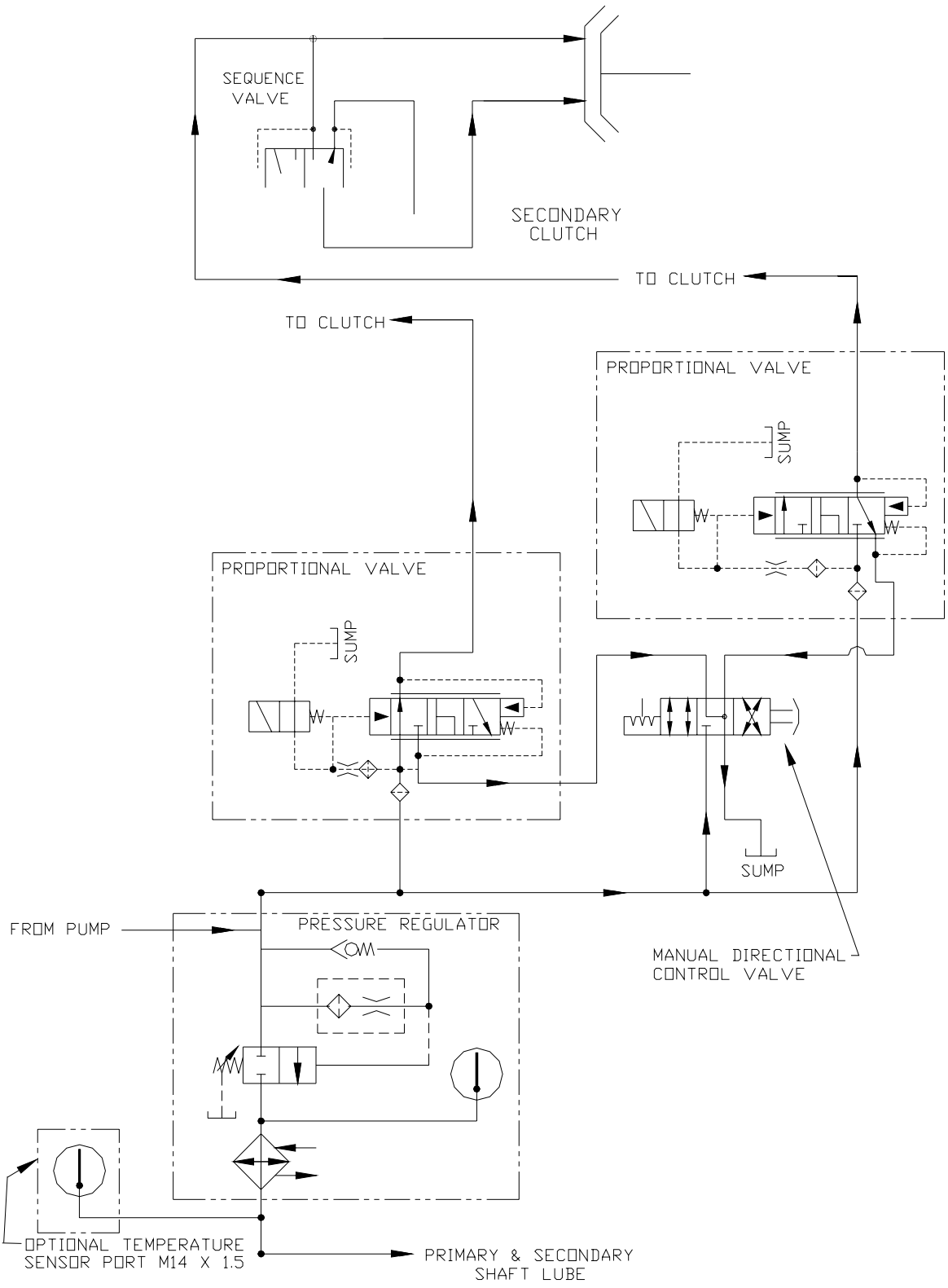


Figure 5. Hydraulic Schematic (GP control valve) - Assy 1021658

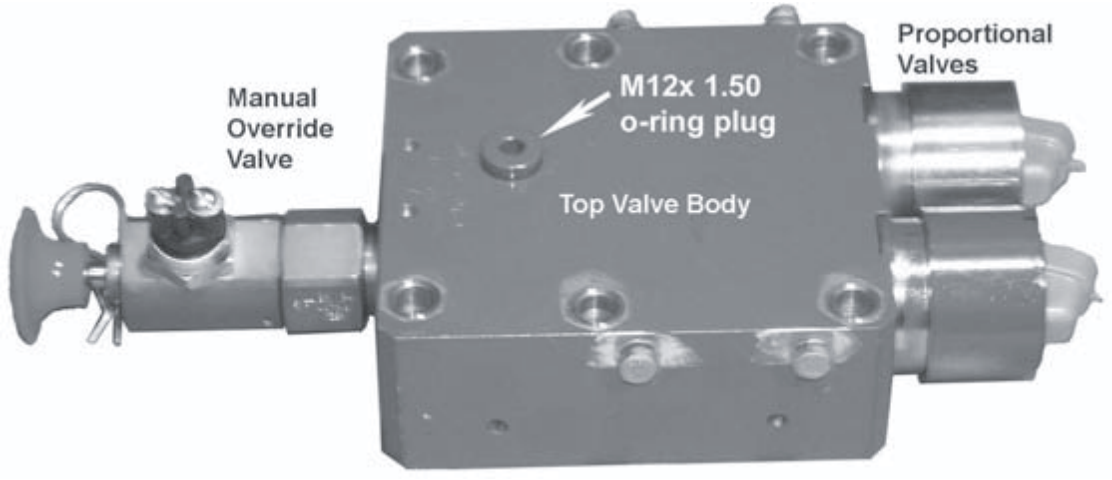


Figure 6. Top Hydraulic Valve Body Assembly

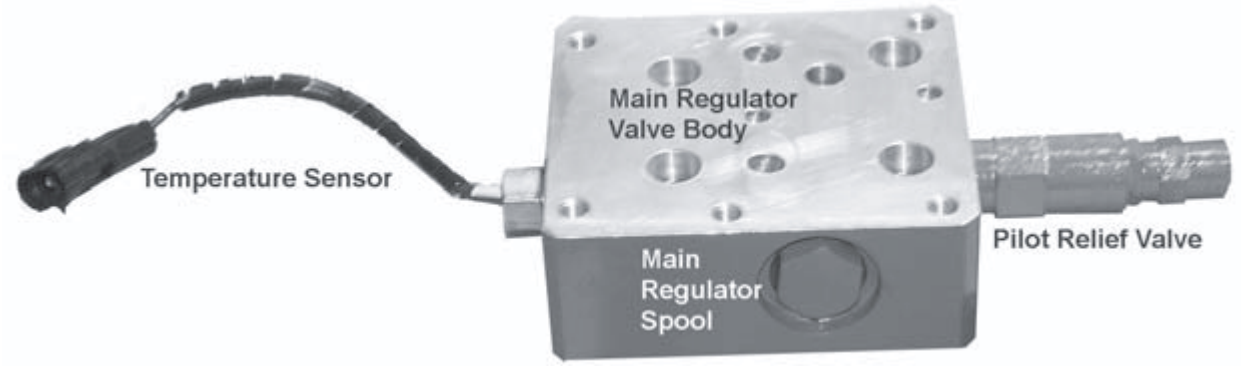


Figure 7. Main Regulator Hydraulic Valve Assembly (1020729)

Figure 8. Main Regulator Assembly (1021658)

GP Control Valve Electronic Control Interface (Profile or E-Troll Module)

Note: Some installations will consist of the hydraulic portion of this valve, and the Electronic Control Interface will be replaced by an appropriate electronic control system.

The electronic portion of the GP Control Valve fastens to the hydraulic portion of the GP Control Valve, and is located on the top surface.

⚠ WARNING

If the ambient temperature of this mounting location exceeds 180°F, the Electronic Control Interface must be relocated to a cooler area. Contact Twin Disc for proper harnessing instructions.

This module contains the electronic circuitry to control the proportional cartridges that are used to engage the clutches based on the commands from the operator. Clutch apply pressure rate of rise (profile) is factory set with the use of internal circuitry. The initial fill level is factory set with an adjustment screw that is embedded in the bottom surface of the Profile or E-Troll Module and sealed. This can be field adjusted if necessary by authorized personnel with the proper instrumentation. There are different control module types for Quickshift marine transmissions (MGX), both with and without the trolling (E-Troll) feature. All electrical wiring for the marine transmission system controls are routed through this interface module. The vessel battery power (12 vdc or 24 vdc) is supplied to the electronic interface only, and never directly to the hydraulic proportional valves. Two red led lights are used to identify the proportional cartridge valve that is energized, and a green led is used to identify when power is provided to energize one of the clutches. Flashing lights are used in troubleshooting. Signals are provided to power a customer supplied relay to allow engine starting only when in neutral. A Transmission oil temperature sensor is not required for the Quickshift marine transmission (MGX) models. Engine speed and propeller speed sensors are required for transmissions with E-Troll. The following figures show the various versions of Electronic Profile or E-Troll Module.

⚠ WARNING

Do not connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

Figure 9. Electronic Profile Module (MGX non-troll)

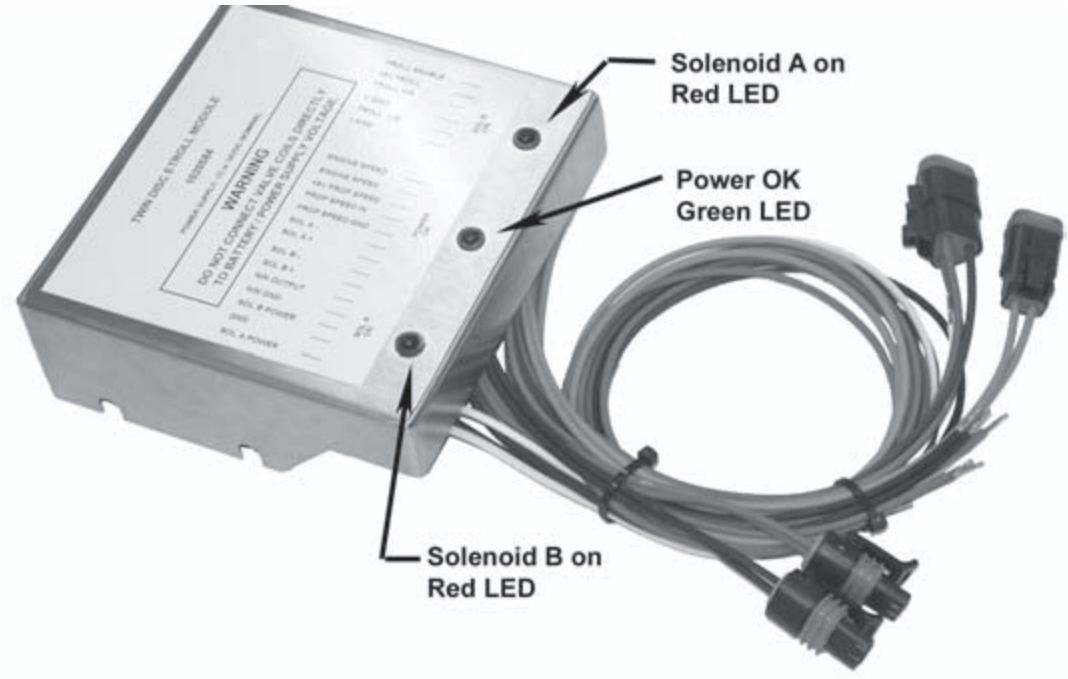


Figure 10. Electronic E-Troll Module (MGX E-Troll)

Hydraulic System with GP Control Valve

The oil pump draws oil through the strainer from the oil sump and discharges it through the heat exchanger to the oil filter. Filtered oil enters the control valve through the inlet port. The incoming oil (Assembly 1020729) is supplied to the main pressure regulating relief pilot cartridge and the main regulating valve cartridge, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. The incoming oil (Assembly 1021658) is supplied to the main pressure regulating valve and is supplied in parallel paths through a ball check valve and an orifice with filter to quickly regulate and dampen pressure oscillations, satisfying the main pressure requirements of the transmission, cascading all remaining oil flow into the lubrication circuit. Oil not used for clutch engagement flows past the regulator piston to become lubrication oil. Lubrication oil flows through the lubrication oil circuit in the transmission to lubricate and cool the clutches and bearings.

Main pressure is supplied to the inlet of each proportional valve, and to the inlet of the manual direction control valve. In Neutral, the inlet port of both clutches is connected to the sump. Since the area behind the clutch pistons is open to sump, the clutches are disengaged.

When one of the clutches is commanded to engage, the proportional valve directs main pressure to a passage in the clutch shaft. The oil is directed to a small area chamber behind the clutch apply piston and also against the sequence (“S”) valve that is located in the clutch shaft. The pressure on the small area of the clutch apply piston quickly moves the piston to engage the clutch at a low capacity level. The pressure rises until the “S” valve opens, allowing the high pressure oil to be supplied to the large area of the clutch apply piston, providing a rapid increase in the clutch capacity. The rate-of-rise is controlled electronically and prefills the engaging clutch at a predetermined level and then increases to full pressure, following a predetermined timing sequence. The initial prefill level is factory adjustable by means of an adjustment screw embedded in the bottom surface of the electronic interface. Field adjustment of this feature should never be attempted without special equipment and knowledge of its use to prevent serious mechanical damage to the marine transmission or vessel.

Clutch release occurs when the proportional valve is de-energized and the oil from the small area of the clutch apply piston is allowed to flow to sump through the control valve and the oil from the large area of the clutch apply piston is allowed to flow to sump through a dump ball in the clutch housing, and through the “S” valve through a passage in the shaft into the transmission sump.

The electronic interface portion of the control valve allows only one proportional valve to be energized at a time, thus, only one clutch can be engaged at a time,

and the oil from the disengaged clutch is vented to sump (atmospheric pressure). The clutch return springs move the disengaged clutch's piston to the disengaged position minimizing clutch plate drag.

Note: Installations with this valve include an oil filter with the proper filtering characteristics. This valve requires a filtration level of 16 micron at an efficiency of 98% (beta ratio = 75) or better.

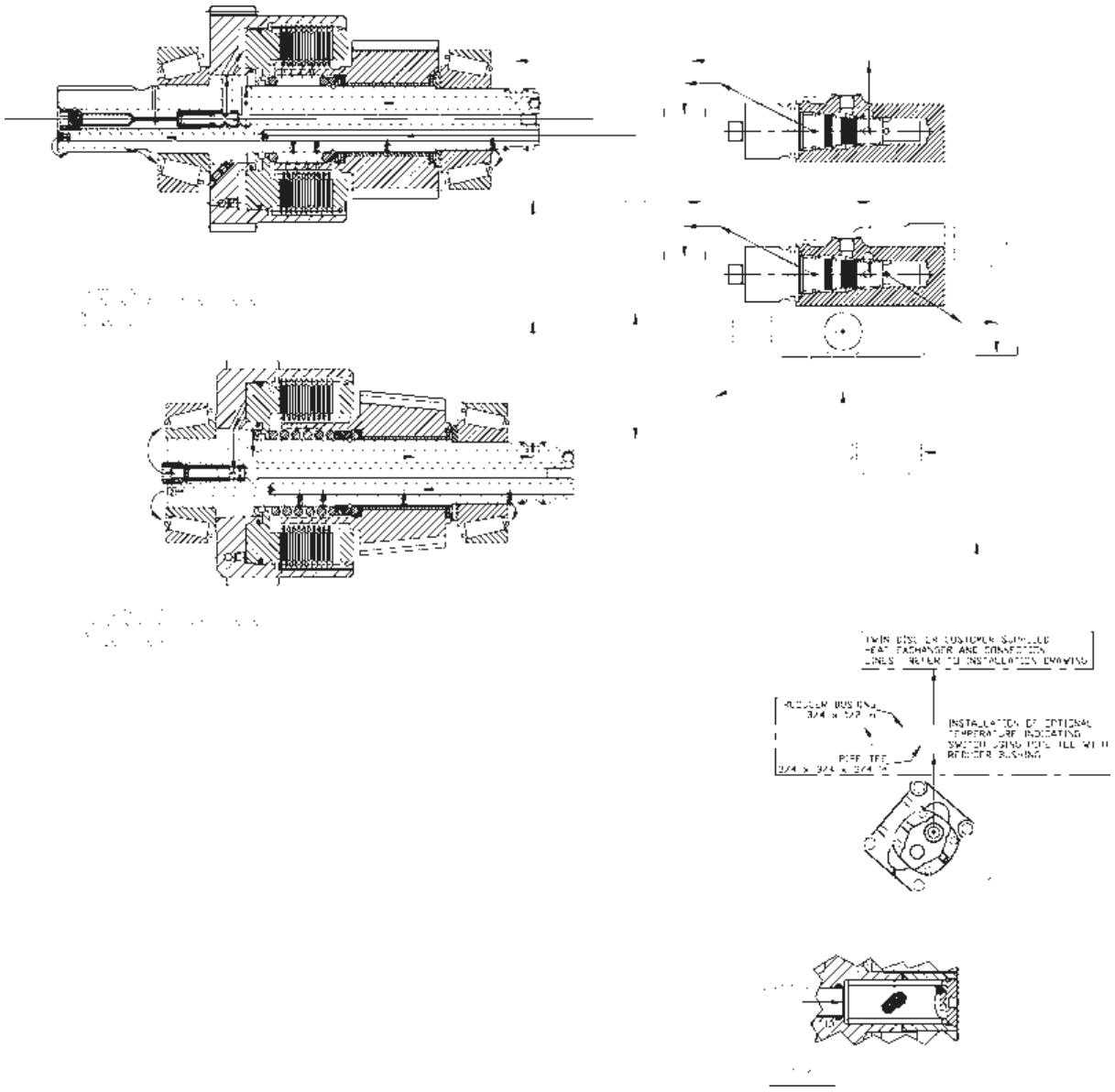


Figure 11. Hydraulic Schematic (MGX-5135A)

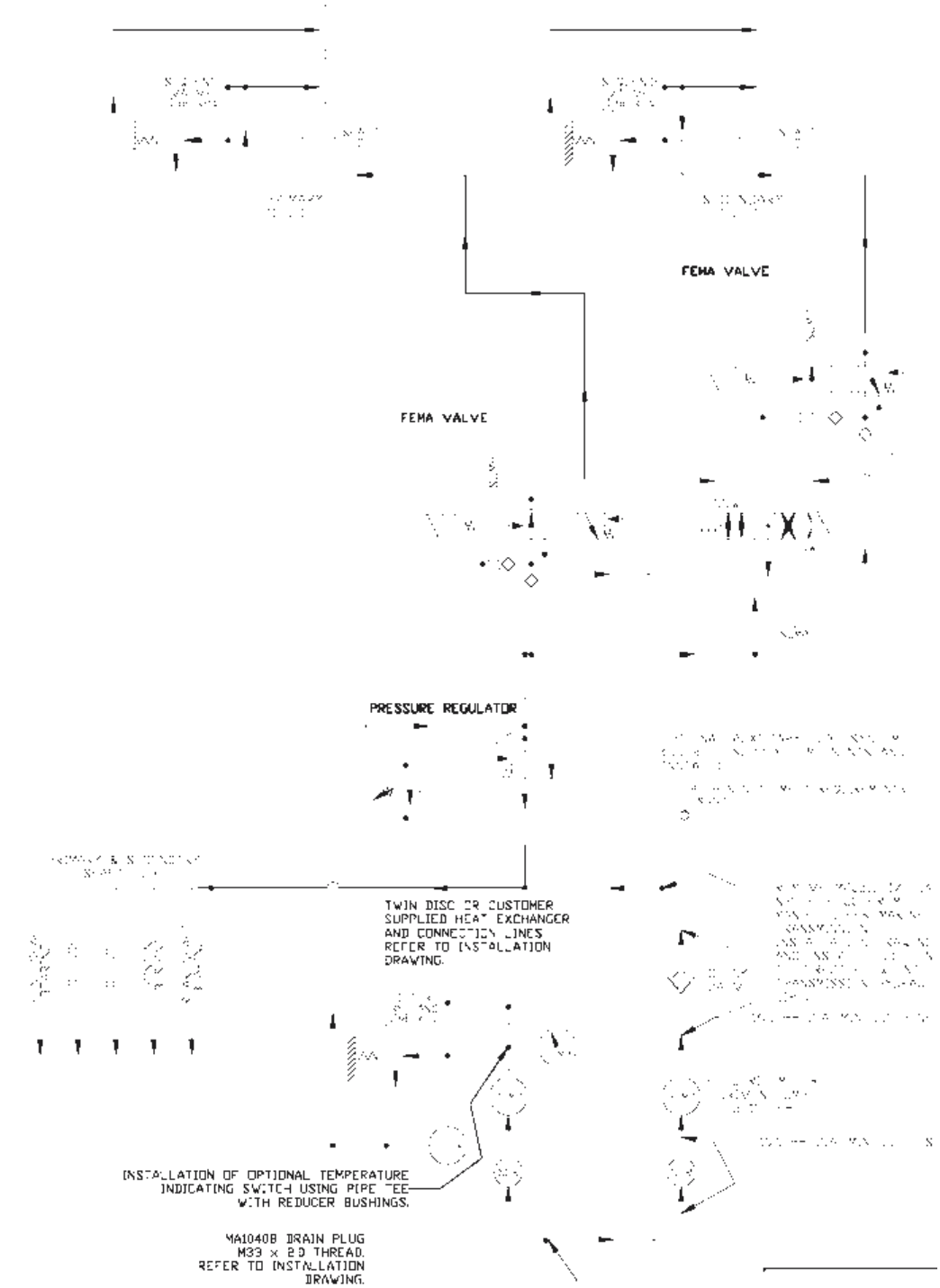


Figure 12. Hydraulic Schematic JIC Symbols

Manual Direction Control Valve Operation

The manual direction control valve is locked in the NEUTRAL (center) position during normal operation. There are three possible positions of the manual direction control valve stem. If conditions exist that the operator wishes to manually operate the transmission for any reason, the operator can remove the locking pin from the direction control valve, and push the stem into the valve for the engagement of clutch A, or pull it out of the valve for the engagement of clutch B. The manual direction control valve has an integral switch with contacts that are closed only when the manual direction control valve is in the NEUTRAL position. This switch must be wired such that the engine cannot be started while clutch A or clutch B is engaged.

⚠ CAUTION

Engagement of a clutch with the Manual Direction Control Valve should only be done with the engine at idle speed.

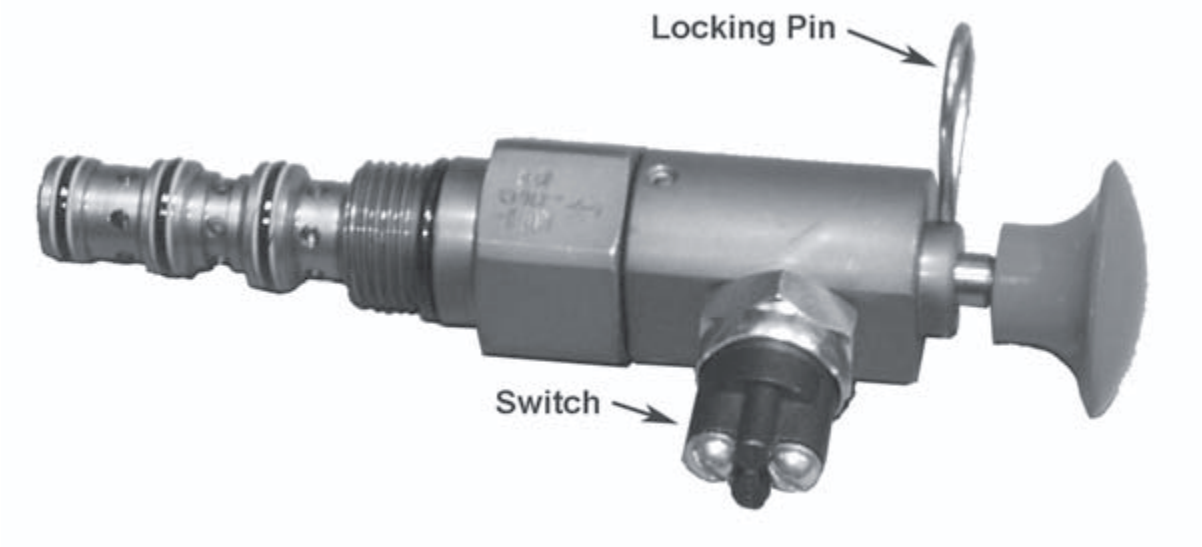


Figure 13. Manual Direction Control Valve

Power Take-off (Optional)

There is a separate manual (part number 1020075) which describes the operation, installation, troubleshooting, and service of the optional Power Takeoffs (PTO) for this marine transmission.

Live Power Take-off (PX-11824)

The live PTO drives accessories using engine horsepower. Since the live PTO connects the accessory to the primary shaft of the transmission via a direct coupling, the accessory is driven whenever the engine is running.

Hydraulic Clutched Power Take-off (PX-11615 Series)

The PX-11615 model has a keyed PTO output shaft. THe PX-11615A model has internal splines and accepts an SAE J744 size “C” pump.

The hydraulic clutched PTO also allows accessories to be driven using engine horsepower. Since the PTO is attached to the primary shaft of the transmission, the accessories can be driven any time the engine is running. The PTO is engaged by rotating the lever of the PTO control valve.

The hydraulic clutched PTO operates with an engaged clutch pressure greater than that of the transmission’s primary and secondary clutches. For this reason the PTO control valve (pressure increasing valve) is in the transmission’s hydraulic circuit before the control valve inlet and pressure regulator. Pressurized oil from the filter is directed to the PTO control valve with the overage oil flowing to the transmission’s control valve.

Power Flow

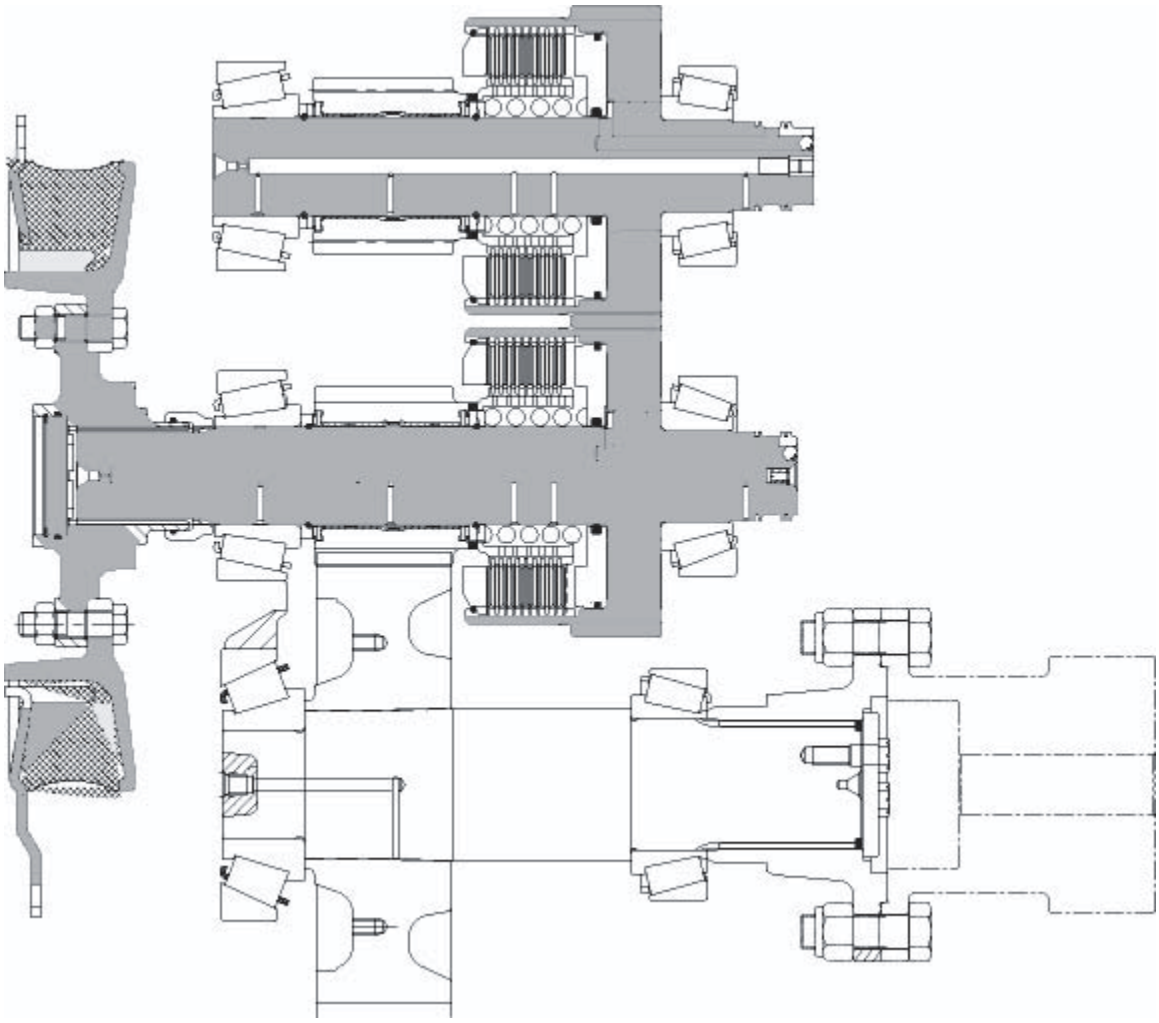
Input power to the transmission is through a torsional coupling mounted on the engine flywheel. The coupling is splined to the forward end of the primary (forward clutch) shaft causing the primary shaft to rotate in engine direction during engine operation. Power is transmitted to the secondary shaft by means of the transfer gear teeth on the outer diameter of the primary clutch housing. These teeth are in constant mesh with gear teeth on the of the secondary clutch housing causing the secondary shaft to rotate in anti-engine direction. The primary and secondary pinions on their respective shafts are in constant mesh with the output gear, which is connected to the output shaft through a keyless tapered joint.

Application of the primary clutch locks the primary pinion to the primary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in anti-engine direction. Application of the secondary clutch locks the secondary pinion to the secondary shaft causing the pinion to turn in the shaft direction and causing the output shaft to rotate in engine direction.

Note: The following power flow illustrations are shown merely as examples of power flow and may not pertain specifically to your unit.

Neutral

When in neutral the primary and secondary shafts, transfer gears and clutch friction plates rotate at engine speed.

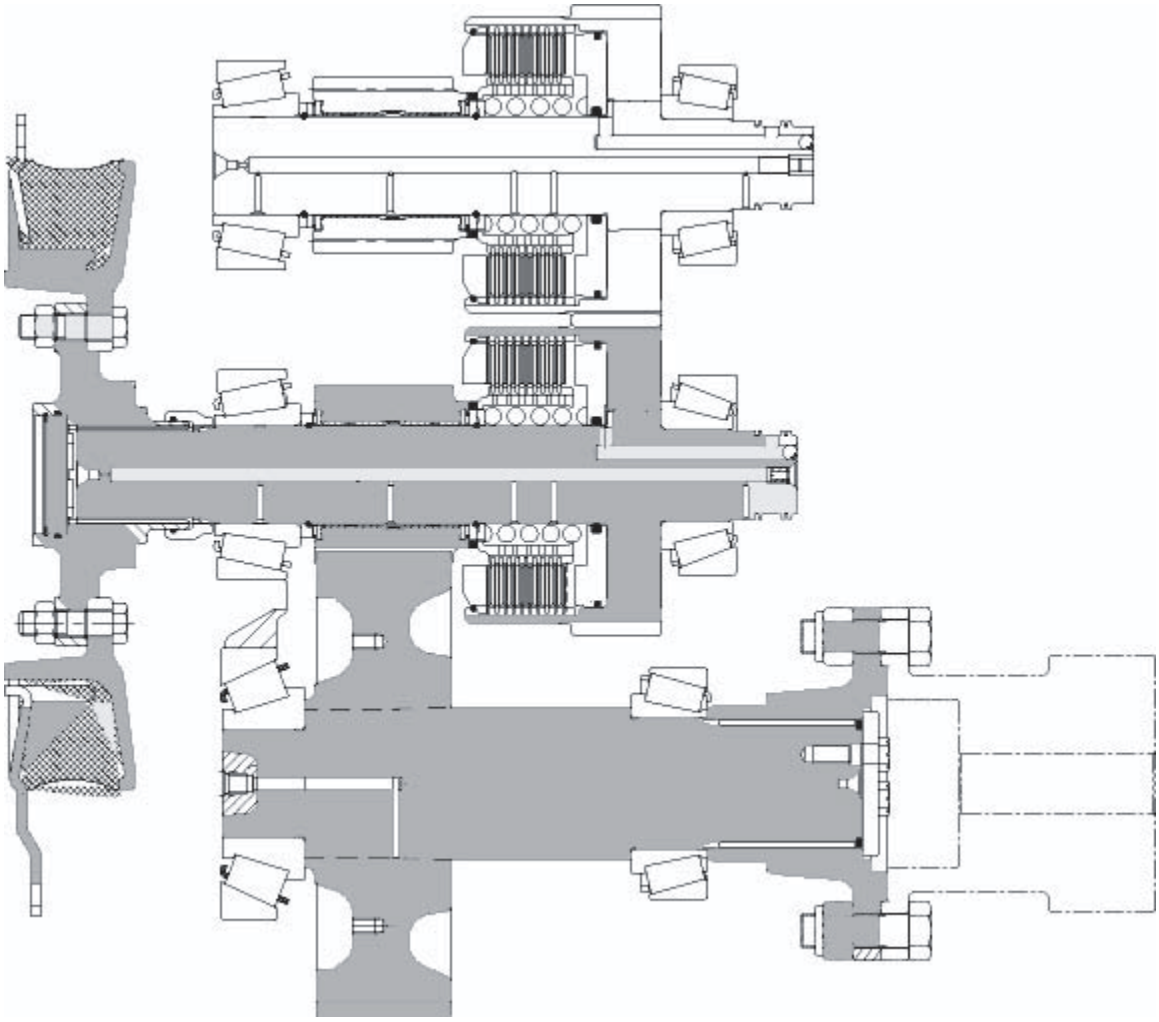


Operation_mg5135sc_N1

Figure 14. Example of Power Flow in Neutral

Primary

When the primary position is selected, hydraulic pressure is applied to the primary clutch piston clamping the friction and steel clutch plates together. The primary input pinion will then rotate at engine speed and direction because the steel plates are spline-connected through the clutch hub assembly to the pinion. Because the primary input pinion is in mesh with the output gear, the output gear and shaft will rotate in anti-engine direction. The secondary input pinion will be backdriven (engine direction) when the unit is in the primary position.

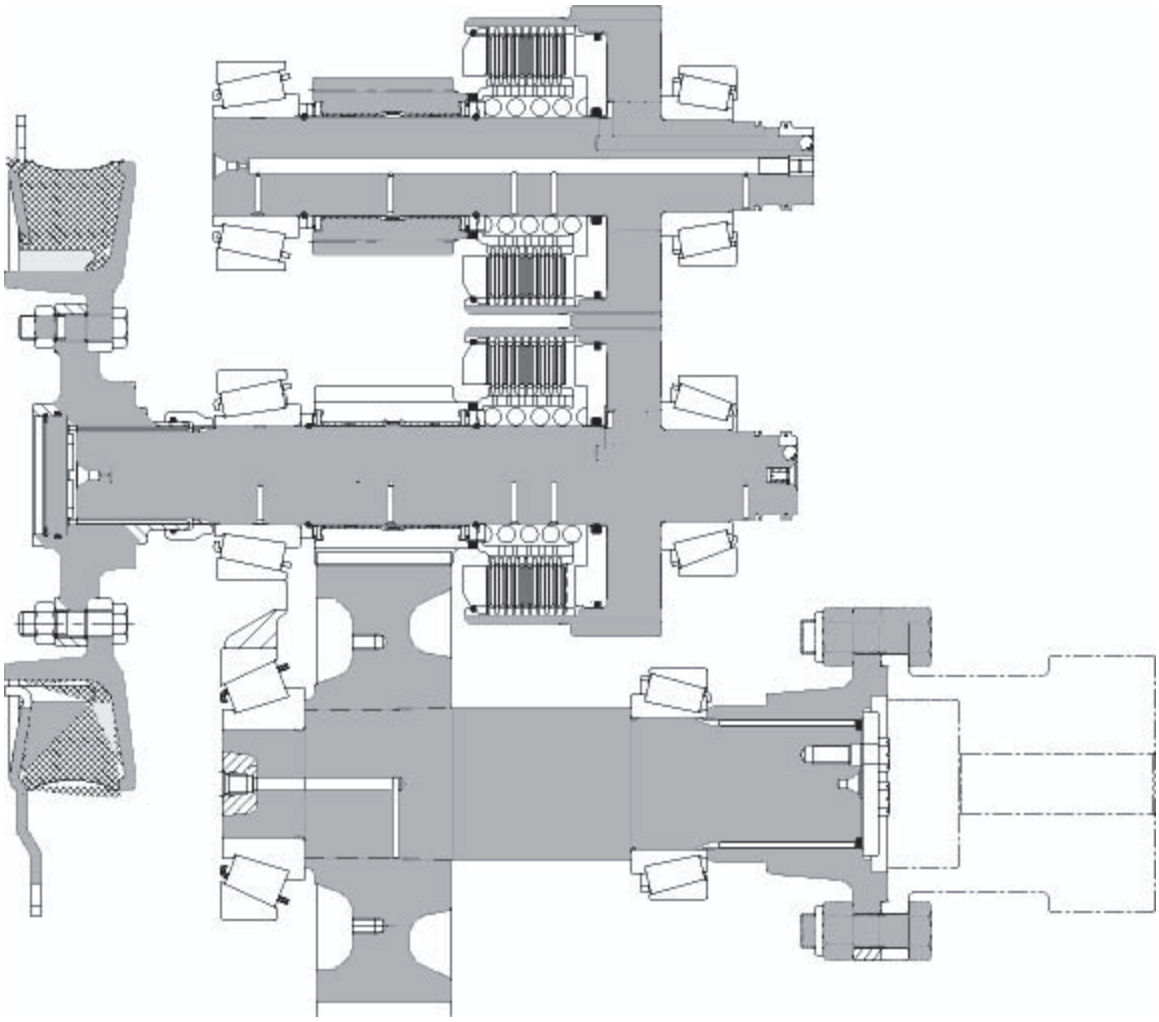


Operation_mg5135sc_P1

Figure 15. Example of Power Flow with Primary Clutch Engaged

Secondary

In secondary, the same parts are turning that were turning in neutral. When the secondary position is selected, hydraulic pressure is applied to the secondary clutch piston clamping the friction and steel plates together. The secondary input pinion will then rotate at engine speed and anti-engine direction, because the steel clutch plates are spline connected through the clutch hub assembly to the input pinion. Because the secondary input pinion is in mesh with the output gear, the output gear and shaft will rotate in engine direction. The primary input pinion will be backdriven (anti-engine direction) when the unit is in the secondary position.



Operation_mg5135sc_S1

Figure 16. Example of Power Flow with Secondary Clutch Engaged

NOTES

Preventative Maintenance

In-boat Maintenance and Repair

Certain transmission maintenance/repair procedures can be accomplished in the boat provided sufficient space exists to work. These procedures are:

- ❑ Removing and installing the oil pump.
- ❑ Changing the filter.
- ❑ Removing, cleaning and installing the suction strainer.
- ❑ Removing and installing the control valve.
- ❑ Removing and installing the manifold.
- ❑ Service clutch pack assemblies.

Note: Further disassembly/reassembly of the primary or secondary shafts will require removal from the engine, and the use of tools and equipment normally not available on board the vessel.

General Maintenance

Overhaul Interval

A complete overhaul and thorough inspection of the unit should be made at the same time as the scheduled engine overhaul. Refer to Cleaning and Inspection for more detailed inspection instructions.

Oil System

Oil Level

The oil level should be checked daily or every 10 hours. Check oil level before starting the engine to confirm that the transmission has oil in it. With the engine running at low idle and the transmission in Neutral, check the oil again. The oil level should be near the “low” oil level mark. Transmission oil temperature should be in the normal operating range prior to finalizing the oil level between the low and full marks on the oil level gauge.

Oil and Filter Change Interval (Maximum)

Note: A suction screen is located in the suction line to the pump, and the oil filter (if equipped) is located in the pump outlet line. Both should be checked and cleaned at the stated intervals.

With a new transmission, change the oil and filter element(if equipped),and clean the suction strainer (screen) within the first 50 hours of operation. Change oil and filter element and clean the screen after each 1000 hours thereafter or more often if conditions warrant.

For a rebuilt transmission, check the filter element (and/or screen) after eight hours of operation. If the filter and/or screen is clean, install a new filter element (if equipped) and then change the oil and filter element after 1000 hours of service. If the filter is dirty, change the element and operate for another eight hours. Check the filter again. Continue this cycle until the filter is clean and then change the oil and filter after 1000 hours of service or more often if conditions warrant.

Draining

Drain the transmission by removing the O-ring plug at the rear side at the bottom. Use a 27 mm wrench to loosen the drain plug.

Oil Suction Strainer

Remove and clean the pump suction strainer at every oil change or sooner if necessary. The suction strainer is located in the manifold below the pump. See Engineering Drawings for suction strainer location. (See discussion under oil change interval.)

Type Oil Recommended

See Description and Specifications.

Filling

1. Remove the filler breather in the top of the transmission.
2. Fill the transmission's sump with the proper weight and type oil. See Description and Specifications for oil recommendations.
3. Start the engine and let it idle with transmission in neutral until oil is circulated throughout the hydraulic system. Add oil if necessary to bring the oil level up to the "low" mark with the engine at low idle.
4. With the oil at operating temperature, transmission in neutral, and the engine running at low idle, check the oil level with the oil gauge. Add or remove oil if necessary to bring the oil level to "FULL" mark on the oil gauge. Allow the oil temperature to cool to normal cold oil conditions (perhaps overnight). Check the oil level while cold at low idle engine speed while in neutral. This is the proper oil level with cold oil. Make note of the oil level in the cold conditions for future reference. **DO NOT** overfill the tranmission. The oil level should not be over the full mark at operating temperature.

⚠ IMPORTANT

Liquid sealant must cure for a minimum of 24 hours prior to contact with oil.

Periodic Visual Inspection

General

- ❑ Check the mountings for tightness or damage such as cracks. Tighten loose mountings and replace damaged parts.
- ❑ Check pressure and temperature gauge where applicable.
- ❑ Periodically, inspect the drive line and the input and output shaft oil seals for leakage. Replace parts as required.
- ❑ Inspect unit nameplates for looseness and corrosion. Tighten mounting screws that are loose and replace nameplates that are corroded.
- ❑ Inspect and oil the exposed stem of the Manual Direction Control Valve for corrosion protection.

Torsional Coupling

DO NOT obstruct the flywheel housing vents preventing the free flow of air for cooling the coupling. The ambient temperature of the air around the coupling should be between -6° C (22° F) and 80° C (176° F). Assure baffles are installed properly so hot air is ported out of the housing.

Visually inspect the element after the first 100 hours of operation and every 2000 hours thereafter, or every six months, whichever comes first. Torsional vibration, misalignment, degradation by contaminants (oil), heat, ultraviolet radiation, and excessive system torque can cause cracks or other signs of distress to appear on the surface of the rubber. The above-described items affect the life of the coupling element. Perform a complete inspection whenever the transmission is removed from the engine for any reason.

When inspecting the flexible coupling, look for evidence or conditions identified in the following steps:

- ❑ Cracks in the surface of the rubber. May be caused by torsional vibrations, excessive misalignment or exposure to contaminants (heat, petroleum products, chemicals, ozone, ultraviolet radiation, etc.) excessive system torques.
- ❑ Separation of rubber from flex plate on coupling plate or deterioration of the rubber-to-metal bond. See above.

- ❑ Deterioration of the rubber element, as evidenced by sponginess or by black carbon-like dust on rubber surface may be caused by contaminants or excessive heat, either external or internal to the coupling.
- ❑ Cracked, bent or otherwise damaged flex plate or coupling plate.
- ❑ Bolt holes in flex plate or coupling plate elongated or deformed. This could be caused by improperly assembled parts, loose parts, vibration or improperly torqued parts.
- ❑ Bolts/nuts—bent, worn or stripped threads.

Inspect the hub, looking for the following:

- ❑ Damaged or worn splines.
- ❑ Cracked parts.
- ❑ Oil seal surface for wear or damage.

Replace any defective parts including defective fasteners that are found.

Heat Exchanger Check

Inspect heat exchanger oil lines for leaky connections, kinks, cracks or other damage. Replace damaged lines. Heat exchangers furnished by Twin Disc to be used for salt water applications have zinc rods installed at the inlet and outlet heads. These rods must be checked every 90 days. If over 50% of the rod is disintegrated, it should be replaced to provide effective protection. Excessive corrosion of the zinc rod indicates electrolytic action. A careful inspection should be made to determine if this action is caused by a short circuit or external grounded electric current. If these conditions do not exist, it is evident that the corrosion is due to local electrolysis. If rods are corroded with foreign materials, they should be cleaned with a wire brush.

Troubleshooting

Troubleshooting of Electric Control Valve

General

The following charts are intended as a guide for determining the cause of problems that could be encountered and the corrective actions for those difficulties.

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Pressure Test Kit

The Digital Pressure Transducer Kit (BOM 42168) provides two pressure transducers (0 to 500 psi) with hydraulic quick couplings, a power supply box for the transducers, and cables needed to connect the transducers to the power supply box and the signals out of the power supply box to a customer supplied digital volt meter. Contact the Twin Disc Service Department, Racine Wisconsin for specific information concerning this test kit.

One principle of troubleshooting is to start with the simple and move to the more difficult. Check the simple items first. Run the simple test first. Then move to the more difficult.

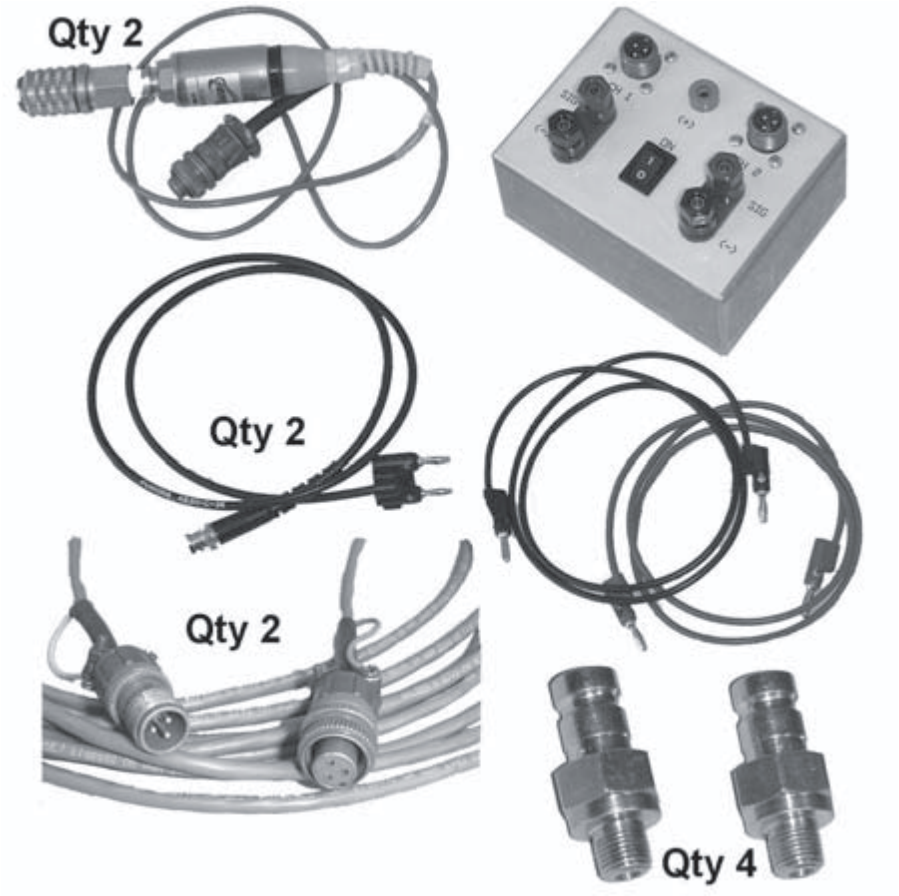


Figure 17. Test kit 42168

Troubleshooting of GP Control Valve with Electronic Interface

General

The transmission is one part of a complete power package. Problems in the input power system or the output power delivery components can cause problems to develop in the transmission. It is therefore important that the entire power package be considered when problems are encountered.

Electronic Interface LED Indicators

The electronic interface control modules have one green and two red led indicator lights. The green power light is illuminated ony when the transmission is in gear.

The following table lists the reasons for the various conditions where lights are illuminated. This should guide in troubleshooting problems. See the wiring schematics in the Installation Section.

Troubleshooting Tables begin on the next page.

Table 17. LED Light Status

Light Status	Profile Generator (Non trolling)	E-troll Module
Green light on	Supply voltage > 9.0 volts.	Supply voltage > 9.0 volts.
Red light on	Valve coil command on.	Valve coil command on.
One red light flashing	All Units: Open circuit in an energized valve coil circuit. MG Units Only: Valve coil leads shorted together or low coil current.	Open circuit in an energized valve coil circuit or valve coil leads shorted together or low coil current.
Both red light flash simultaneously	MG Units: Power is applied to solenoid A and B switch inputs at the same time. MGX Units: Not applicable.	After entering troll from neutral with both voltage and current troll speed signals present, or power is applied to solenoids A and B switch inputs at the same time.
Both red light flash alternately	Not applicable	Either or both speed signals missing.

Table 18. Troubleshooting Chart - GP Control Valve with Electronic Interface

Symptom	Cause	Remedy
1. Low main oil pressure.	1-1. Partially clogged oil strainer.	1-1. Remove and clean oil strainer.
	1-2. Contamination on Pilot Relief Valve seat.	1-2. Disassemble the Pilot Relief Valve and clean. Service the tranmission oil filter.
	1-3. Contamination on Main Valve Cartridge.	1-3. Clean or replace Main Valve Cartridge and service the transmission oil filter.
	1-4. Broken piston rings on clutch shafts.	1-4. Remove the collector and inspect the piston rings.
	1-5. Damaged or worn oil pump assembly	1-5. Replace damage or worn oil pump assembly (pump is not serviceable).
	1-6. Engine idle speed too low.	1-6. Raise engine speed.
2. No oil pressure or erratic low pressure at control valve tap.	2-1. Oil pump suction strainer plugged.	2-1. Remove and clean strainer.
	2-2. Oil level low.	2-2. Check oil level and correct.
	2-3. Air leak on suction side of pump.	2-3. Correct cause of air leak.
	2-4. Pump drive on reverse clutch shaft broken.	2-4. Disassemble and repair as required.
	2-5. Pilot Relief Valve or Main Regulating Valve stuck in open position	2-5. Remove, disassemble, clean and repair the Pilot Relief Valve. Remove, clean or replace the Main Regulating Valve. This valve cannot be disassembled.
	2-6. Oil pump defective.	2-6. Replace oil pump.
	2-7. Leaking heat exchanger has caused oil to be lost overboard.	2-7. Replace heat exchanger.
3. High main oil pressure	3-1. Pilot Relief Valve is out of adjustment.	3-1. Adjust Pilot Relief Valve. Replace if necessary.
	3-2. Main Regulating Valve orifice missing.	3-2. Replace main Regulating Valve cartridge.

Table 18. Troubleshooting Chart - GP Control Valve (continued)

Symptom	Cause	Remedy
4. High temperature.	4-1. Improper oil level.	4-1. Check and fill (or drain) with proper oil to the correct level.
	4-2. Faulty heat exchanger.	4-2. Inspect, repair or replace heat exchanger.
	4-3. Clutches slipping.	4-3. Check clutch apply oil pressure. If pressure is normal, remove, disassemble and repair slipping clutch. If pressure is low, replace Proportional Valve and service the transmission oil filter.
	4-4. Bearing failure.	4-4. Overhaul marine transmission.
	4-5. Air leak on suction side of pump.	4-5. Inspect and correct cause of suction leak.
	4-6. Control valve malfunction.	4-6. Inspect, repair or replace control valve.
5. Excessive noise.	5-1. Bearing failure.	5-1. Overhaul marine transmission.
	5-2. Worn or damaged input coupling.	5-2. Remove marine transmission. Replace worn or damaged coupling.
	5-3. Excessive torsional vibration.	5-3. Select proper torsional coupling.
	5-4. Worn or damaged gears.	5-4. Overhaul marine transmission.
	5-5. Improper alignment.	5-5. Check alignment of engine transmission output flange to propeller shaft. Correct as necessary.
	5-6. Damaged propeller.	5-6. Repair propeller.
	5-7. Misfiring engine.	5-7. Repair engine.
6. No neutral.	6-1. Clutch plates warped.	6-1. Remove clutch plates. Overhaul unit.
	6-2. Disengaged clutch has apply pressure.	6-2. Replace Proportional Valve. Service transmission oil filter.

Table 18. Troubleshooting Chart - GP Control Valve (continued)

Symptom	Cause	Remedy
7. Harsh engagement.	7-1. Faulty Proportional Valve.	7-1. Replace Proportional Valve.
	7-2. Faulty temperature sensor (if equipped).	7-2. Replace Temperature Sensor.
	7-3. Profile Generator defective or out of adjustment.	7-3. Replace Profile Generator. Adjust if proper equipment is available.
8. Low lube pressure	8-1. Pump flow output too low.	8-1. Replace pump.
	8-2. Pump suction strainer plugged.	8-2. Remove, clean, inspect and install the suction screen.
	8-3. Air leak on suction side of pump.	8-3. Inspect and correct cause of suction leaks.
	8-4. Lube relief valve malfunction.	8-4. Remove and clean or replace parts as necessary.
	8-5. Broken piston rings.	8-5. Replace damaged piston rings.
9. Oil spilling out of breather.	9-1. Oil level too high.	9-1. Adjust oil level.
	9-2. Wrong type of oil.	9-2. Draw and refill with recommended oil.
10. Low clutch apply pressure	10-1. Low Main Pressure.	10-1. See paragraph 1.
	10-2. Defective Proportional Valve.	10-2. Replace Proportional Valve.
	10-3. Low voltage to Profile Generator.	10-3. Verify that green (voltage supply) light and red (clutch energized) lights are bright.

Disassembly

The following procedure is for complete disassembly of the unit. Prior to this procedure, the transmission should be removed from the boat. Qualified personnel should do the work in a fully equipped facility.

Note: Photos are intended to illustrate the procedure and may not be consistent with previous disassembly steps.

Prepare Transmission for Disassembly

Note: During the service of this unit, all O-rings, gaskets and seals must be replaced. It is good practice to keep the used components (O-rings, gaskets, and seals) with the appropriate components for reference during the inspection and assembly process (to make sure you don't forget the quantity, size, etc.).

⚠ CAUTION

Flat washers are used under all fasteners where the head of the fastener contacts an aluminum surface.

Pipe threads called out as PT (British Standard Pipe Taper) on drawings and in this text are different from NPT threads. PT threads and NPT threads are NOT interchangeable. Adapters are available from several manufacturers to convert PT threads to NPT threads.

Most pusher screws used in the disassembly of this transmission are threaded through aluminum parts. ALWAYS LUBRICATE the threads of the pusher screw before threading it into the mating part. When installing pusher screws, avoid rapid tightening with an impact wrench or similar device. If an impact wrench is used with the pusher screws the threads may gall or seize in the aluminum part. Tighten pusher screws in an even manner to avoid damaging components.

Component Identification

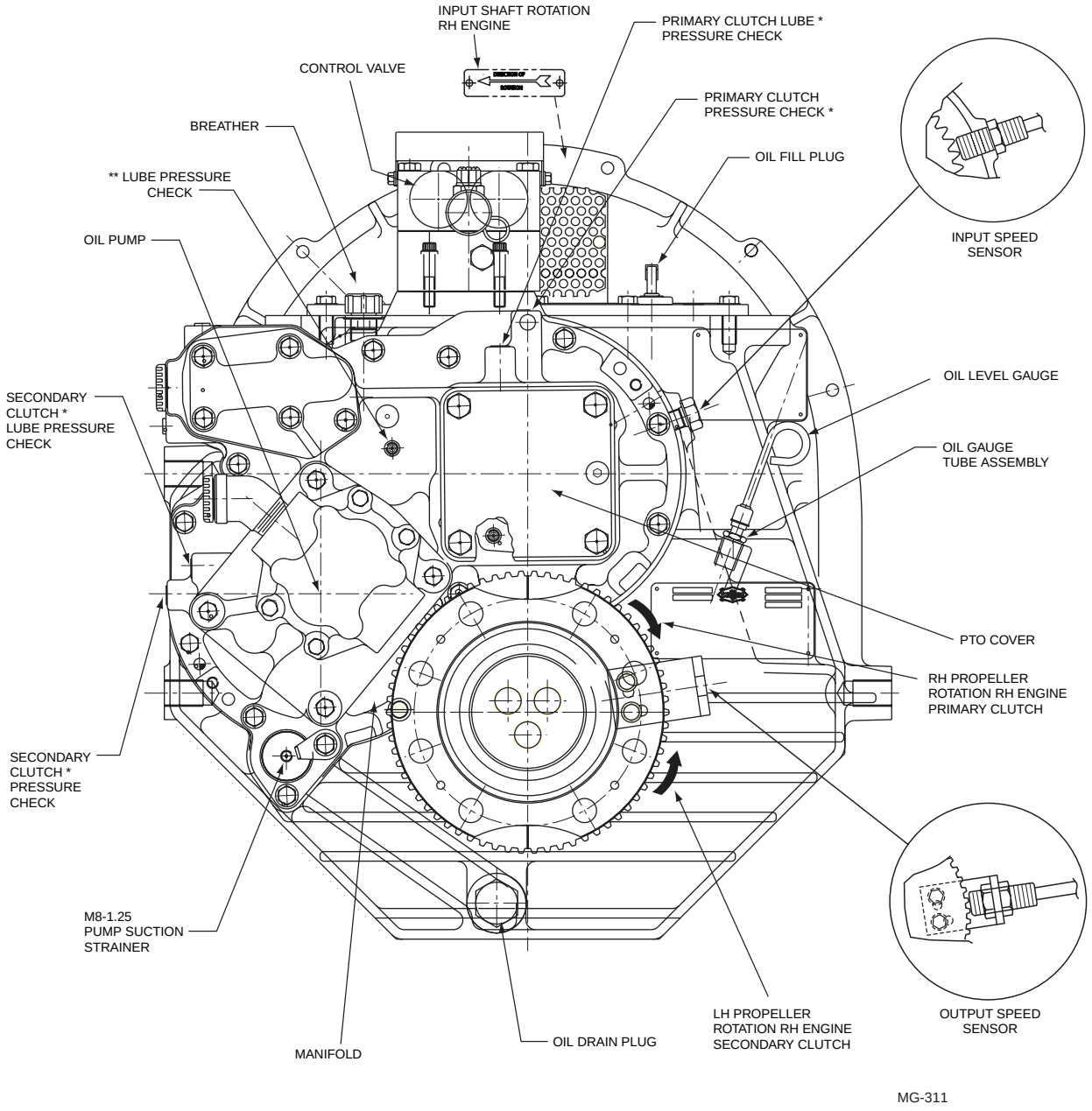
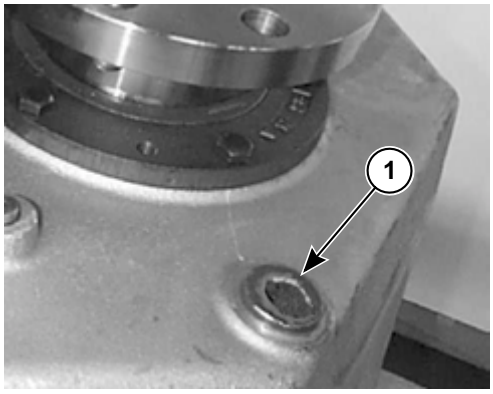


Figure 18. GP Control Valve with Electronic Interface

Prior to Removal

1. Remove drain plug (1) and drain oil from transmission.



MG_029

Figure 19. Drain Plug (1)

2. If equipped, disconnect the water supply hoses to the heat exchanger.

3. Mark the output flange and companion flange so they will always be assembled identically.

4. Disconnect the output and companion flanges.

5. Disconnect linkage, wiring and plumbing and remove any items that would interfere with the removal of the transmission. It may be advisable to remove the input and output speed sensors (if equipped) to avoid damaging them during transport.

6. Support the transmission with a hoist and remove the mounting capscrews.

7. Support the rear of the engine with blocks if necessary.

8. Remove the 12 capscrews that secure the transmission to the engine.

9. Push the transmission away from the engine. Remove the transmission. Remove the input coupling from the engine flywheel and secure it to the transmission for transport.

Remove External Parts

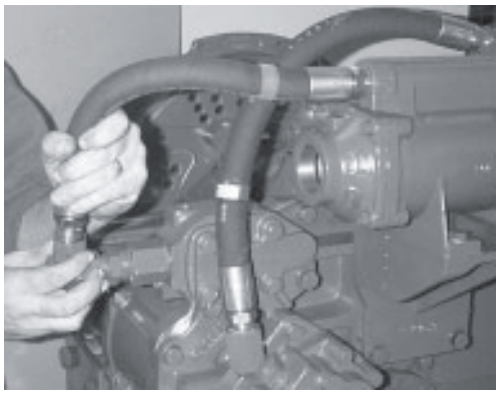
Note: Place the main housing in the upright position to remove the following parts. Be sure the main housing is securely supported.

Input and Output Speed Sensors (If Equipped)

1. Disconnect the input speed sensor and output sensor connector.
2. Loosen the jam nut securing each sensor.
3. Remove the input speed sensor and the output speed sensor from the main housing.

Heat Exchanger (If Equipped)

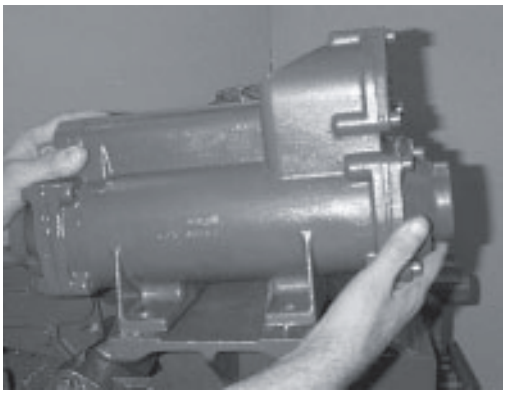
1. Disconnect the heat exchanger hoses. Disconnect the swivel end of the hose first.



5135_0001

Figure 20. Disconnecting Heat Exchanger Hoses

2. Remove the four screws securing the heat exchanger. Remove the heat exchanger from the bracket.



5135_0002

Figure 21. Heat Exchanger Removal

Control Valve

Note: To aid in assembly, be sure to mark all wire connectors prior to removing the control valve.

GP Control Valve with Electronic Interface - Disconnect the wiring. Loosen the four capscrews. Remove the electronic module.

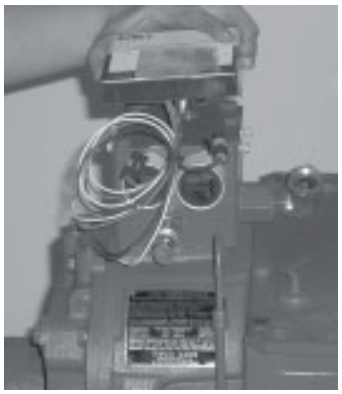


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Figure 22. GP Control Valve with Electronic Interface Removal

Top Valve

1. Remove the six capscrews that retain the top valve.
2. Remove the top valve and gasket. Discard the gasket.

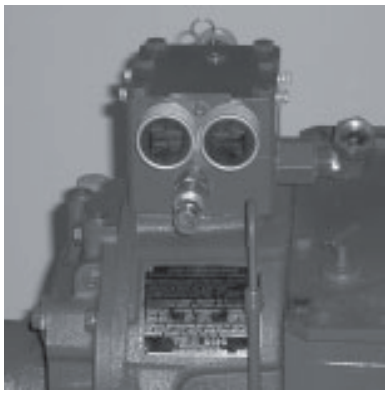

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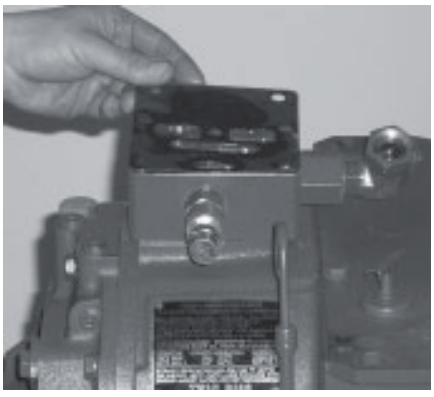
Figure 23. Top Valve Removal

Bottom Valve

1. Remove the four capscrews retaining the bottom valve.
2. Remove the bottom valve and gasket. Discard the gasket.



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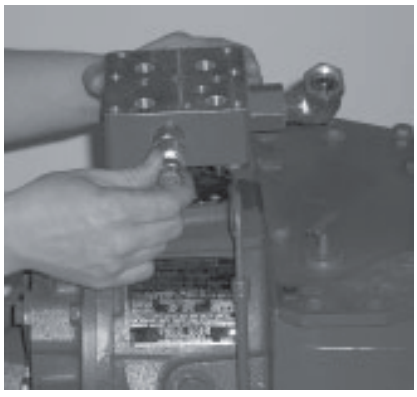
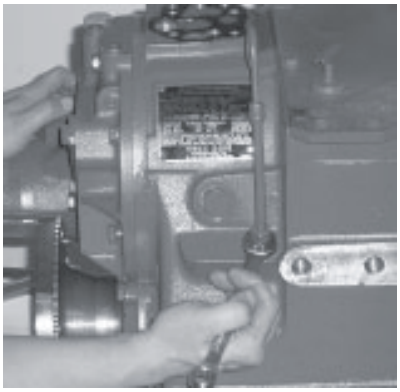


5135_0284

Figure 24. Bottom Valve Removal

Dipstick Tube

1. Remove the dipstick.
2. Remove the dipstick tube retaining nut.
3. Remove the dipstick tube from the front housing.


286_5135

287_5135

Figure 25. Dipstick Removal

Top Cover

1. Remove the eleven M12 x 30 capscrews and one M8 x 20 capscrew with washers retaining the top cover.
2. Gently tap the top cover to break the gasket loose from the main housing.
3. Remove the top cover and gasket from the transmission housing. Discard the gasket.

289_5135

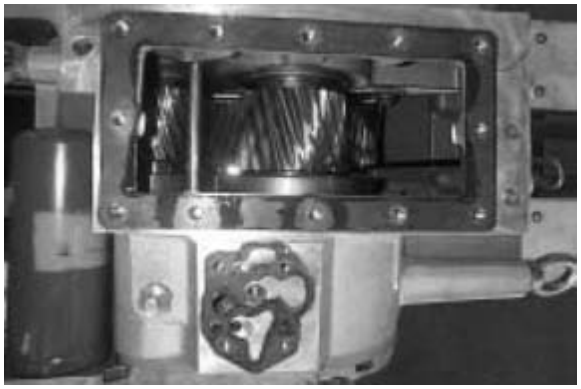

5135_0624

Figure 26. Top Cover Removal

PTO Cover

1. Remove the four M12 x 30 mm PTO cover capscrews.

2. Gently tap the PTO cover, if necessary, to break the cover loose from the main housing.

3. Remove the PTO cover and O-ring.

DCP_1001

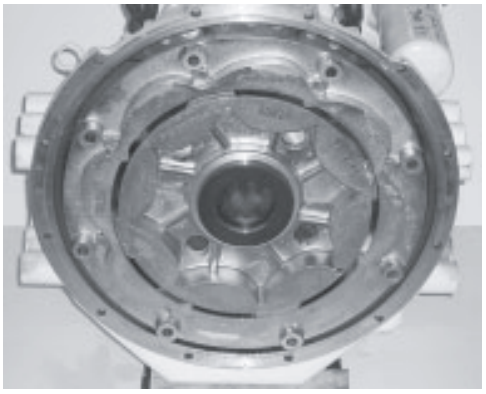
DCP_1004

Figure 27. PTO Cover Removal

Input Coupling

1. Remove shipping wire (if equipped) retaining the input coupling to the input housing.

2. Remove input coupling from input shaft.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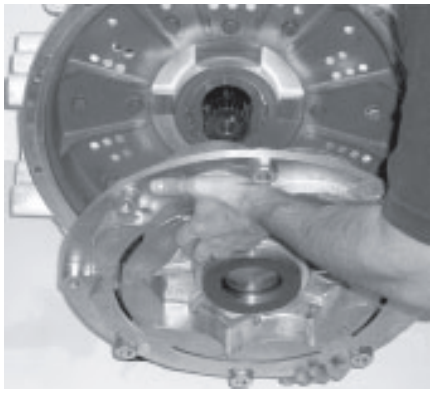
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Figure 28. Input Coupling Removal

Hydraulic Pump

1. Remove the hydraulic pump from the main housing.

5135_402

Figure 29. Hydraulic Pump Removal

⚠ CAUTION

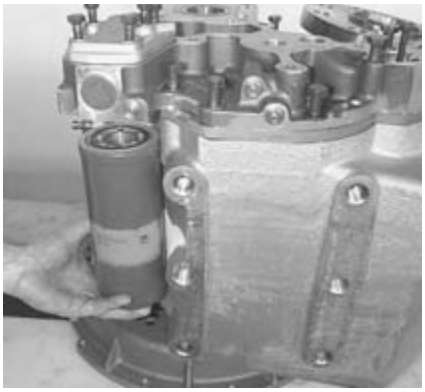
The hydraulic pump can be installed two ways; therefore, before removing the pump, place indexing marks on the pump and the manifold to ensure correct installation. Do not remove the pump pipe plug. Do not disassemble pumps. They are not serviceable.

2. Remove the four capscrews securing the hydraulic pump to manifold assembly and remove the pump and gasket.

Hydraulic Oil Filter

Note: Position the main housing with input end down. Be sure the main housing is securely supported.

Remove the hydraulic oil filter.



5135_405

Figure 30. Hydraulic Oil Filter Removal

Suction Strainer

1. Remove the M12-1.5 capscrew with washer directly below the suction strainer plug. Remove the clamp plate.

2. Thread a M8-1.5 capscrew into the suction strainer plug and pull.

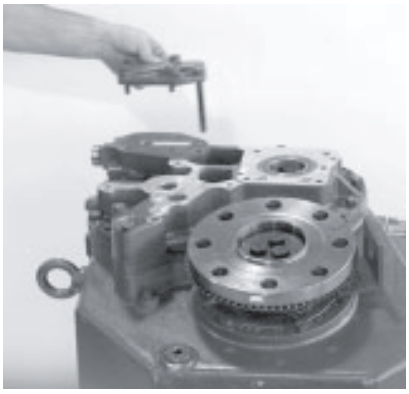
3. Remove the plug and suction strainer.

5135_0625

Figure 31. Suction Strainer Removal

Oil Filter Bypass Cover

Remove filter bypass valve cover.



DCP1010

Figure 32. Oil Filter Bypass Cover Removal

Output Flange

1. Remove the three M12 x 40 output flange clamp screws.
2. Remove the output flange clamp plate.

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Figure 33. Output Flange Clamp Plate Removal

3. Remove the output flange shim.

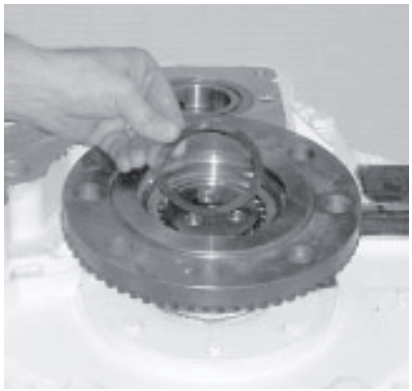

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Figure 34. Output Flange Shim Removal

4. Remove the output flange sealing ring.

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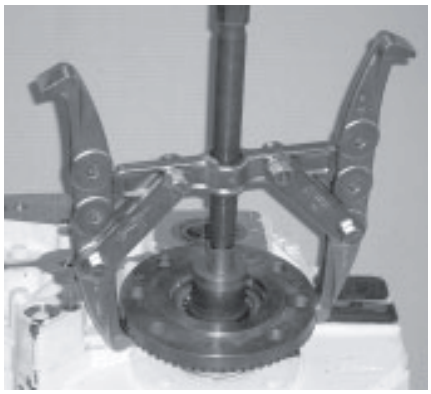
Figure 35. Output Flange Sealing Ring Removal

5. Using a puller, remove the output flange from the output shaft.



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5135_0168

Figure 36. Output Flange Removal

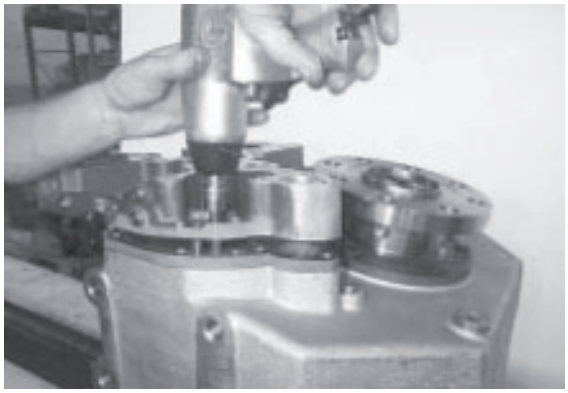
Remove Internal Parts

Manifold

1. Remove the capscrews still retaining the manifold.
2. The manifold is equipped with two pusher screw locations to assist in the removal of the manifold. Thread two M12 mm fully threaded capscrews (lubricated) into the pusher screw locations to push the manifold away from the bearing carrier.

⚠ IMPORTANT

Always lubricate the pusher screw threads before use. Always tighten the pusher screws evenly.



5135_0626

Figure 37. Manifold Removal

3. Lift the manifold and gasket, taking care not to damage the piston rings on the end of the clutch shafts. Discard the gasket.

4. Remove the oil lubrication tube.

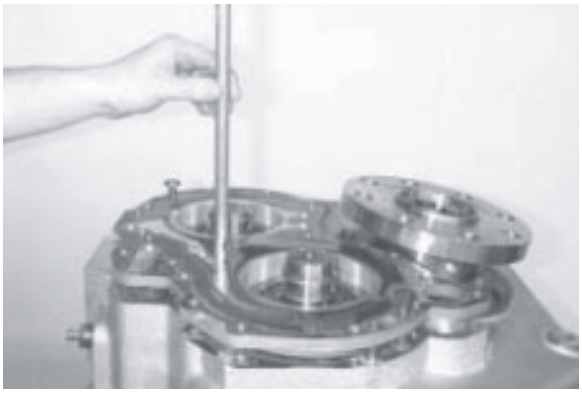


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Figure 38. Oil Lubrication Tube Removal

Secondary Clutch Shaft Manifold Bushing

Note: Only remove the manifold bushing from the manifold if it needs to be replaced. If removed, a new manifold bushing must be installed during assembly.

1. Remove the two flat head screws that retain the manifold bushing.

2. Use a pry bar on the bushing to remove it from the manifold.

5135_0243

5135_0247

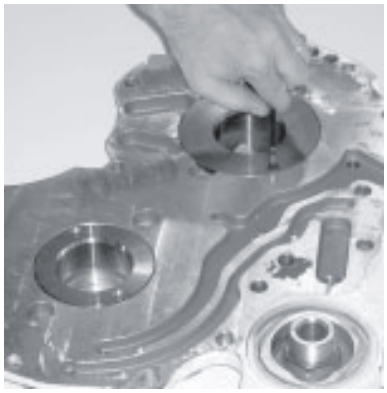
Figure 39. Secondary Clutch Shaft Manifold Bushing Removal

Primary Clutch Shaft Manifold Bushing

Note: Only remove the manifold bushing from the manifold if it needs to be replaced. If removed, a new manifold bushing must be installed during assembly.

1. Remove the two flat head screws that retain the manifold bushing.

2. Use a bearing driver to remove the manifold bushing from the manifold.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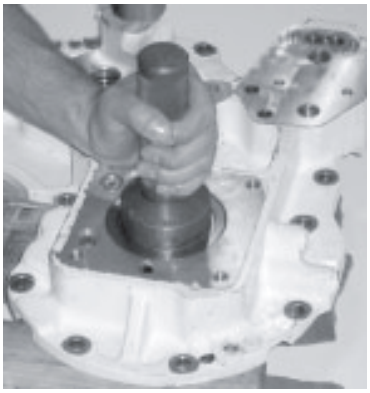
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Figure 40. Primary Clutch Shaft Manifold Bushing Removal

3. Remove the O-ring from the manifold.

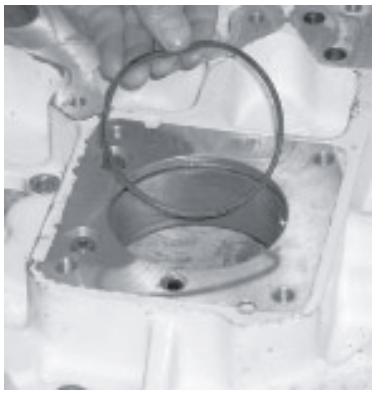
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Figure 41. Primary Clutch Shaft Manifold Bushing O-ring Removal

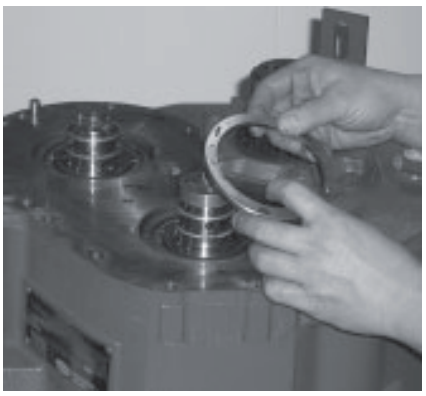
Bearing Shims and Spacer

1. Remove the primary clutch shaft shims and spacer. Tag the components with identifying information.

308_5135

Figure 42. Primary Clutch Shaft Bearing Shims and Spacer Removal

2. Remove the secondary clutch shaft shims and spacer. Tag the components with identifying information.



309_5135

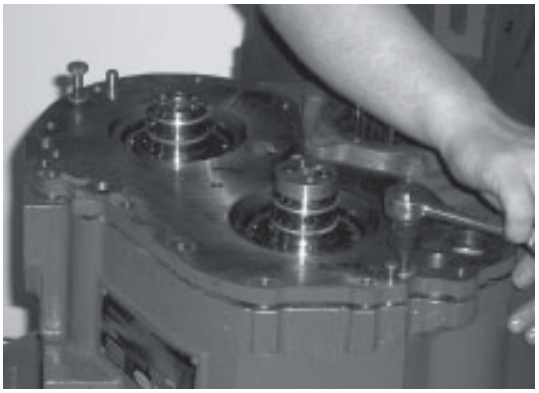
Figure 43. Secondary Clutch Shaft Bearing Shims and Spacer Removal

Rear Bearing Carrier

1. The rear bearing carrier is equipped with two pusher screw locations to assist in the removal of the bearing carrier. Thread two M12 mm fully threaded capscrews (lubricated) into the pusher screw locations to push the bearing carrier away from the main housing.

⚠ IMPORTANT

Always lubricate the pusher screw threads before use. Always tighten the pusher screws evenly.



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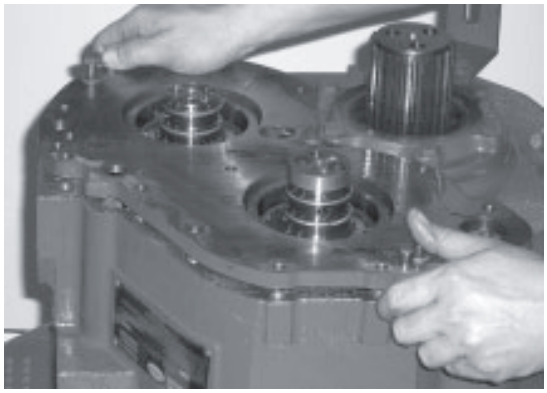


314_5135

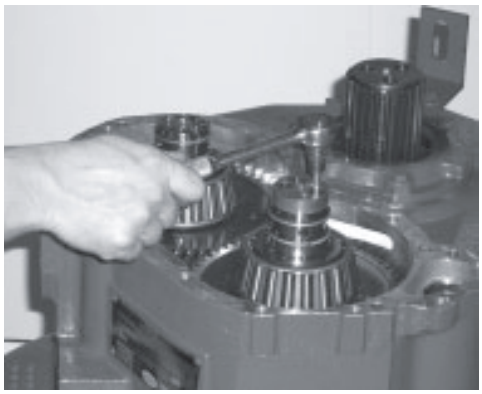
Figure 44. Rear Bearing Carrier Removal

2. Discard the bearing carrier gasket.

Note: Remove the bearing cups from the rear bearing carrier. The bearing cups must be removed for clutch shafts shimming procedure. Use a bearing driver to remove the bearing cups.

Primary and Secondary Clutch Shaft

1. Remove the two M8 x 20 capscrews that retain the pump drive to the secondary clutch shaft. Remove the pump drive.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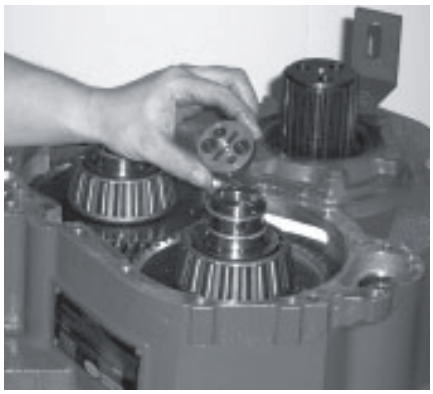
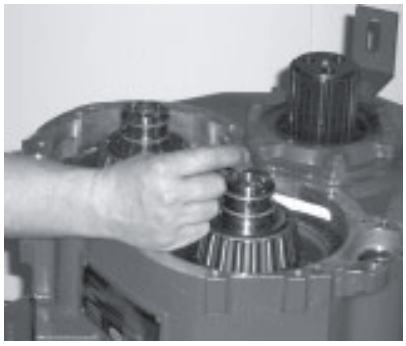

317_5135

Figure 45. Pump Drive Removal

2. Remove the spacer and “S” valve from the secondary clutch shaft. A small wire with a hook on its end can be used to help pull the “S” valve.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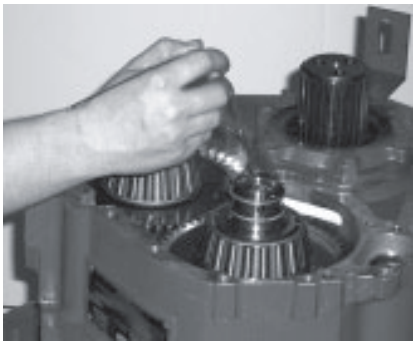
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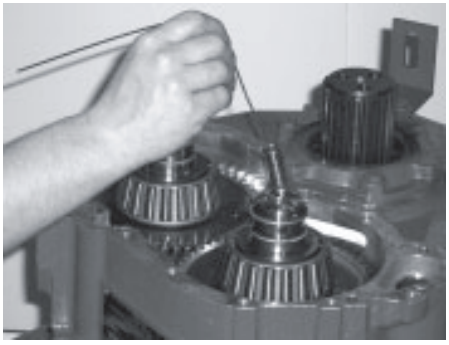
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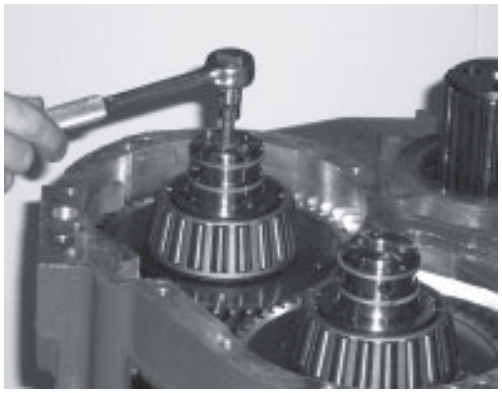
MCV_770F

Figure 46. Secondary Clutch Shaft Spacer and “S” Valve Removal

3. Remove the plug from the center bore of the primary clutch shaft.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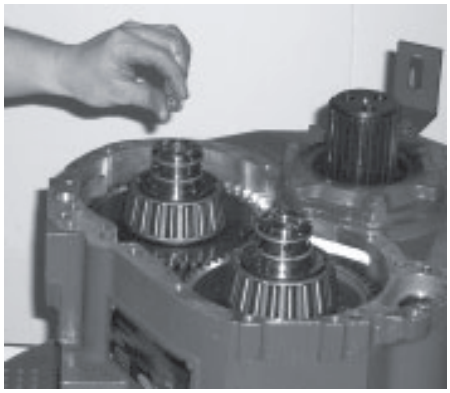
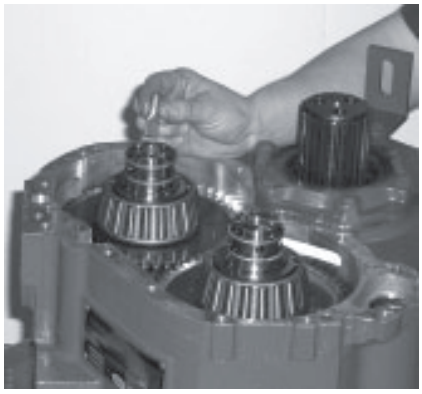

323_5135

Figure 47. Primary Clutch Shaft Plug Removal

4. Remove the spacer and “S” valve from the primary clutch shaft. A small wire with a hook on its end can be used to help pull the “S” valve.

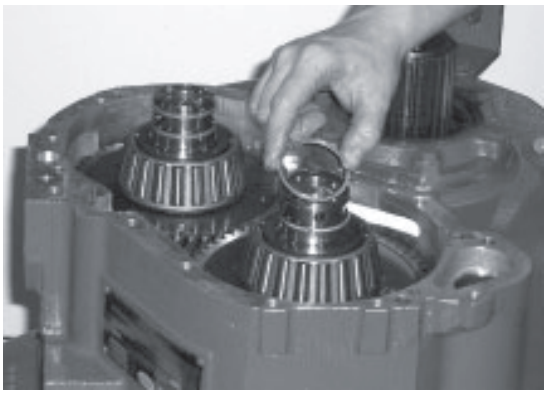

324_5135

325_5135

MCV_770F

Figure 48. Primary Clutch Shaft Spacer and “S” Valve Removal

5. Remove the two piston rings from the end of the secondary and primary clutch shafts.



327_5135

Figure 49. Piston Rings Removal

6. Install an eyebolt in the end of the secondary and primary clutch shafts.

Note: When servicing a 1:1 ratio transmission, it is necessary to remove or install both the primary and secondary clutch shaft assemblies at the same time.

1_to_1_ spacer

Figure 50. Primary and Secondary Clutch Shaft Removal - 1:1 Ratio Transmissions

7. Lift the secondary clutch shaft from the main housing. The front bearing carrier will slide off the shaft and remain in the main housing. The spacer may also come off the shaft.

5135_628 5135_629

Figure 51. Secondary Clutch Shaft and Primary Clutch Shaft Removal

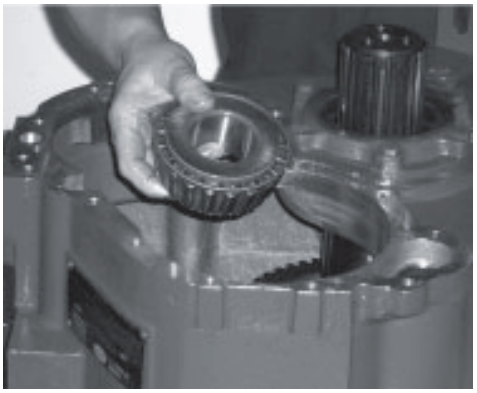
8. Install an eyebolt in the end of the primary clutch shaft.

9. Lift the primary clutch shaft from the main housing. The front bearing carrier will slide off the shaft and remain in the main housing. The spacer may also come off the shaft.

Front Bearing

1. Reach inside the main housing and remove the primary clutch shaft front bearing and spacer if it did not remain on the shaft. Tag the components with identifying information.

2. Reach inside the main housing and remove the secondary clutch shaft front bearing and spacer if it did not remain on the shaft. Tag the components with identifying information.



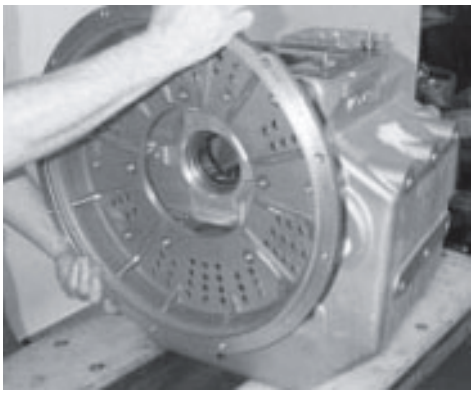
383_5135

Figure 52. Front Bearing Carriers Removal

Input Housing

Note: Place the main housing in the upright position to remove the following parts. Be sure the main housing is securely supported.

1. Remove the twelve M12 x 35 mm capscrews securing the input housing.
2. Remove the input housing from the main housing.

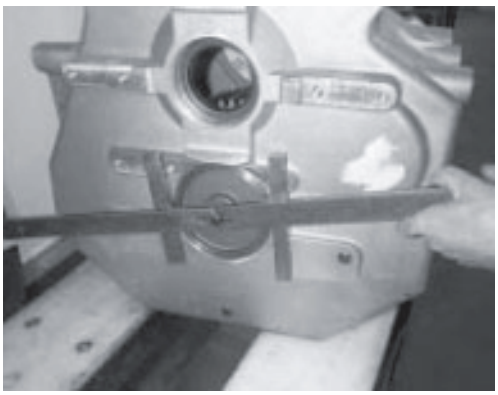


5135_0630

Figure 53. Input Housing Cover Removal

Front Output Cover

1. Thread a M10-1.5 eyebolt into the front output cover.
2. Use a lever and a block of wood to pry on the capscrew to overcome the friction of the front cover O-ring.
3. Remove the front cover. Discard the O-ring.



5135_0631

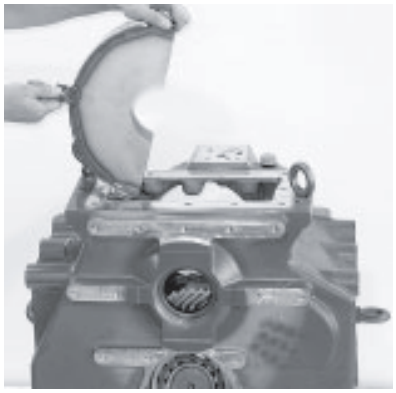
Figure 54. Front Output Cover Removal

Remove Output Gear and Shaft

Output Gear Pan

1. Remove the four capscrews with sealing washers securing the output gear pan to the main housing.

2. Remove the output gear pan through the top opening.



DCP_1034

Figure 55. Output Oil Pan Removal

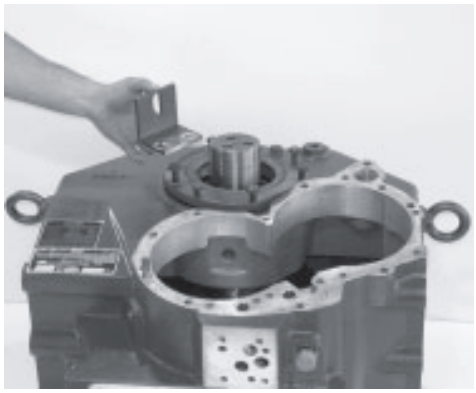
Separate Output Gear From Output Shaft Using SKF Procedure

Note: The MGX-5135SC transmission requires the use of a SKF THAP 300 Oil Injection Kit (see Special Tools) or similar device to separate the output gear from the output shaft.

1. Place the main housing in the face down position to separate the output gear from the output shaft. Be sure the main housing is securely supported.

2. Remove seven capscrews and remove the output shaft seal carrier, speed pickup bracket (if equipped), and shims.

3. Remove the seal from the seal carrier.



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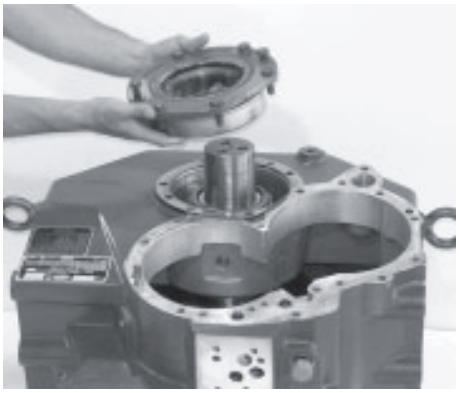


DCP_1038

DCP_1039

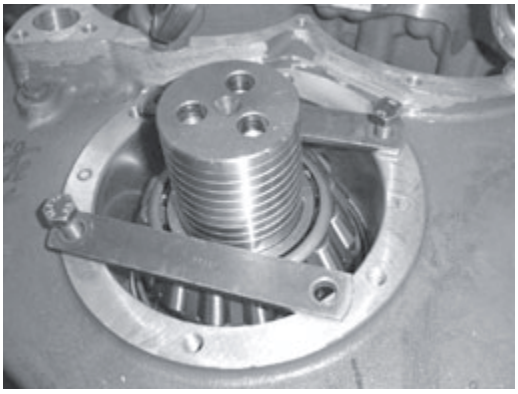
Figure 56. Output Shaft Seal Carrier Removal

4. Remove the rear output bearing cup by pulling the output shaft assembly up.

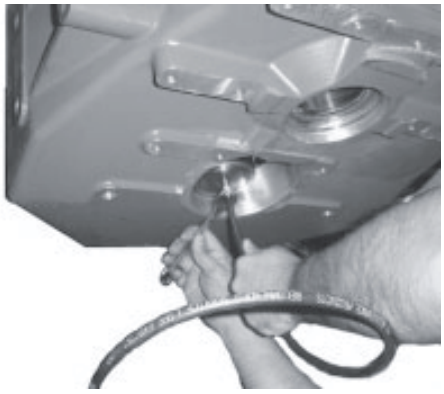
5. Place straps on rear to prevent shaft from coming out.

6. Raise the transmission with a hoist. Install the oil injector into the output shaft. Note that these are special 1/4-19 BSP threads. Support the transmission on suitable blocks.

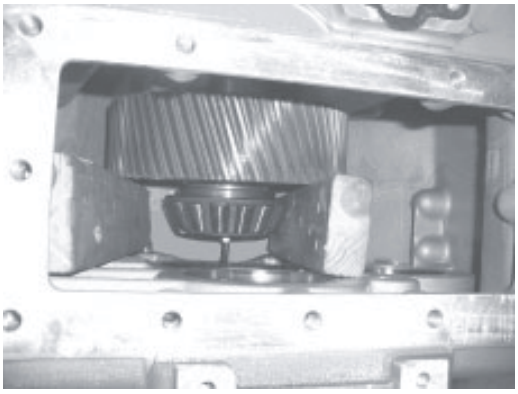
Note: Raise the output shaft and use wooden blocks on each side of the gear to prevent damage to the main housing when separating the output gear from the shaft. Aluminum bar stock also aids in removal of the gear from the housing.



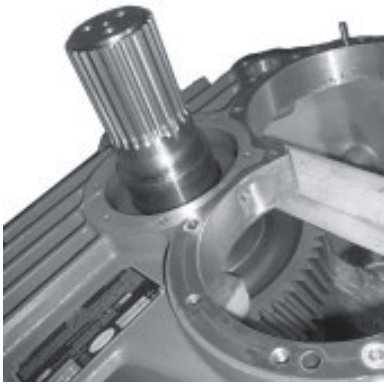
5135_straps



5135_inverted



5135_block



5135_block2

Figure 57. Separating Output Gear From Output Shaft

7. Inject oil with a viscosity of 900 mm^2/S (900cSt) at room temperature into the output shaft until the output gear lifts from the output shaft taper.

   Note: The front output shaft bearing cone will be forced part way off the shaft when the gear comes off the taper, but will probably require additional removal force to remove completely.

8. Lift the unit and remove the SKF fitting.

9. Remove the upper blocks and support the shaft on a block and press the gear and bearing off the shaft.

Output Shaft

1. Use a hoist and lift the output shaft from the main housing.

5135_out_shaft

Figure 58. Output Shaft Removal

2. Remove the output gear through the top cover opening of the main housing. Set the output gear aside.

5135_415

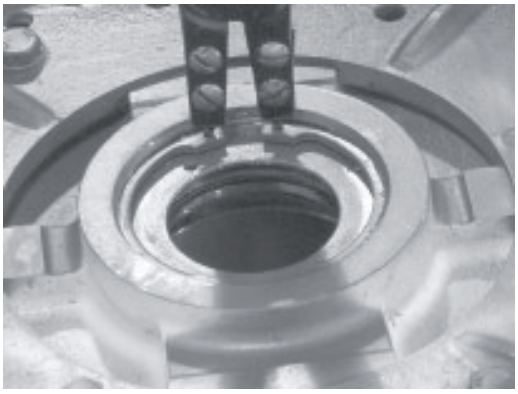
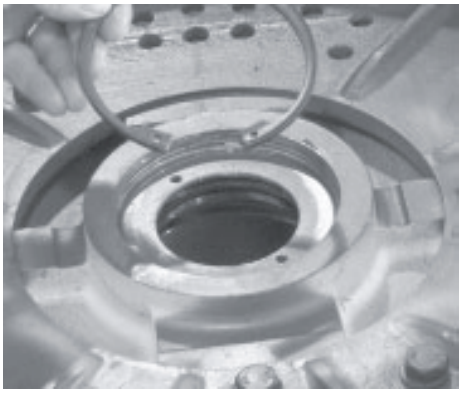
Figure 59. Output Gear Removal

3. Remove the front output bearing cone from the cup.

4. Remove the rear bearing from the shaft by pressing, if it has not already been removed.

Input Shaft Seal

1. Remove the snap ring from the front housing.

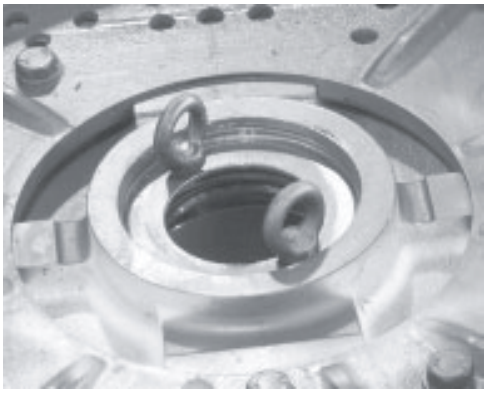
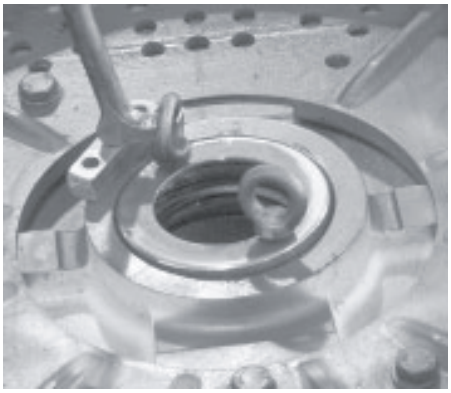



5135_0267 5135_0268

Figure 60. Input Seal Snap Ring Removal

2. Thread two eyebolts into the seal retaining ring.

3. Using two pry bars, carefully pry the seal retaining ring from the front housing.

5135_0270 5135_0275

Figure 61. Input Seal Retaining Ring Removal

4. Remove the O-ring.

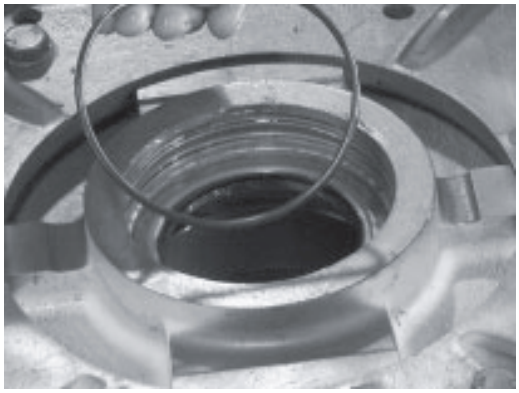


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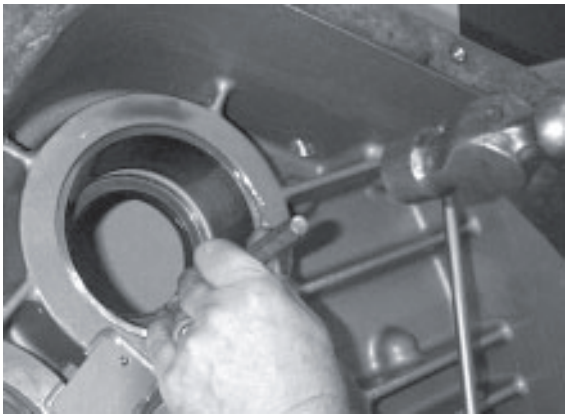
Figure 62. O-ring Removal

5. Turn the front housing over and remove the input shaft seal.



5135_0012

Figure 63. Input Shaft Seal Removal

Front Housing Bearing Cups

If the front housing bearing cups require replacement, weld a bead midway around the circumference of the bearing cup with an electric welder. This will cause the bearing cup to shrink, allowing it to be removed.

weld_bearning_cup1

Figure 64. Example of Welded Bearing Cup

Primary Clutch Shaft Disassembly

1. Remove the rear bearing cone.

   Note: Only remove the cone from the primary clutch shaft if it needs to be replaced. If removed, a new bearing must be installed during assembly.

   a. Cut off the bearing cage and remove the rollers.

   b. Use a “cheese-cutter” type puller to pull on the rear shoulder of the inner bearing race.

   c. Heat the inner race to assist in its removal.

⚠ CAUTION

DO NOT overheat the inner race as it could result in annealing the clutch shaft.

⚠ WARNING

Handle the inner race and shaft with care. The inner race and shaft is HOT.

2. Position the primary clutch shaft with the input end facing up.

3. Remove the snap ring.

DCP_1043

Figure 65. Snap Ring Removal

4. Remove the front needle bearing and thrust washers.

DCP_1045

Figure 66. Front Two Thrust Washers and Needle Bearing Removal

5. Slide the pinion assembly from the shaft.

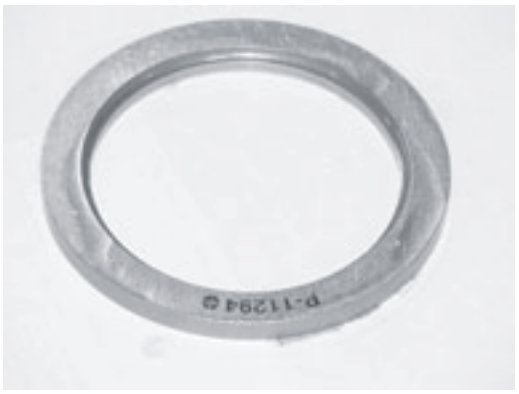
DCP_1046

Figure 67. Pinion Assembly Removal

6. Remove the rear two thrust washers and needle bearing.

Note: Record location of the rear two thrust washers and needle bearing for proper assembly. The first washer removed pilots in the bore of the pinion and the second pilots on the shaft. This thrust washer also has a counterbore to fit over the snap ring.

DCP_1048



MVC_763F

Figure 68. Rear Two Thrust Washers and Needle Bearing Removal

7. Remove the internal snap ring and back plate from the clutch housing.

MG_051

Figure 69. Internal Snap Ring and Back Plate Removal

8. Remove the 9 steel plates and 10 friction plates from the clutch housing.

MG_052

Figure 70. Steel Plate and Friction Plate Removal

9. Position the primary shaft and clutch housing under a hydraulic press.

   a. Place Special Tool T-1802 on the spring retainer.

   b. Compress the release spring enough to expose the snap ring.

   c. Remove the snap ring.

MG_053

Figure 71. Compressing Release Spring and Snap Ring Removal

d. Carefully remove tension on the release spring.

e. Remove the spring retainer and release spring.

MG_054

Figure 72. Spring Retainer and Release Spring Removal

10. Remove the clutch piston from the clutch housing.

    a. Blow compressed air into the hole between the piston ring grooves at the rear end of the shaft to remove the clutch piston.

    b. Remove the piston rings from the outside diameter of the clutch piston and from the outer bore of the small area of the piston.

    c. Remove the O-ring from the inner diameter of the clutch piston.

MVC_772F

Figure 73. Piston Ring and O-Ring Removal

Secondary Clutch Shaft Disassembly

1. Remove the rear bearing cone.

   Note: Only remove the cone from the secondary clutch shaft if it needs to be replaced. If removed, a new bearing must be installed during assembly.

   a. Cut off the bearing cage and remove the rollers.

   b. Use a “cheese-cutter” type puller to pull on the rear shoulder of the inner bearing race.

   c. Heat the inner race to assist in its removal.

⚠ CAUTION

DO NOT overheat the inner race as it could result in annealing the clutch shaft.

⚠ WARNING

Handle the inner race and shaft with care. The inner race and shaft are HOT.

2. Position the secondary clutch shaft with the input end facing up.

3. Remove the snap ring.

DCP1043

Figure 74. Snap Ring Removal

4. Remove the front two thrust washers and needle bearing.

Note: Record location of the front two thrust washers and needle bearing for proper assembly. The first washer to be removed pilots on the shaft and the second one pilots in the pinion bore.

DCP_1045

Figure 75. Front Two Thrust Washers and Needle Bearing Removal

5. Slide the pinion assembly from the shaft.

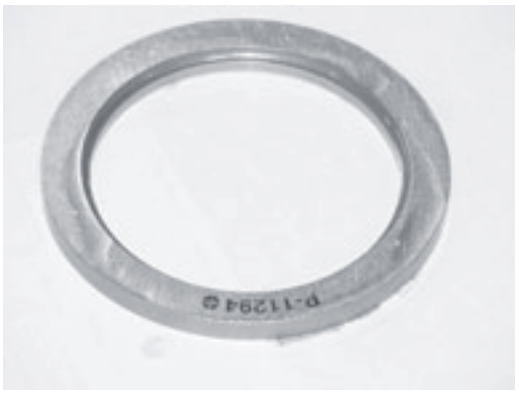
DCP_1046

Figure 76. Pinion Assembly Removal

6. Remove the rear two thrust washers and needle bearing.

Note: Record location of the rear two thrust washers and needle bearing for proper assembly. The first washer removed pilots in the bore of the pinion and the second pilots on the shaft. This thrust washer also has a counterbore to fit over the snap ring.

DCP_1048



MVC_063F

Figure 77. Rear Two Thrust Washers and Needle Bearing Removal

7. Remove the internal snap ring and clutch back plate from the clutch housing.

MG_051

Figure 78. Internal Snap Ring and Clutch Back Plate Removal

8. Remove the 9 steel plates and 10 clutch friction plates from the clutch housing.

MG_052

Figure 79. Steel Plate and Clutch Friction Plate Removal

9. Position the secondary shaft and clutch housing under a hydraulic press.

   a. Place Special Tool T-18502 on the spring retainer.

   b. Compress the release spring enough to expose the snap ring.

   c. Remove the snap ring.

MG_053

Figure 80. Compressing Release Spring and Snap Ring Removal

d. Carefully remove tension on the release spring.

e. Remove the spring retainer and release spring.

MG_054

Figure 81. Spring Retainer and Release Spring Removal

10. Remove the clutch piston from the clutch housing.

    a. Blow compressed air into the hole between the piston ring grooves at the rear end of the shaft to remove the clutch piston.

    b. Remove the piston rings from the outside diameter of the clutch piston and from the outer bore of the small area of the piston.

    c. Remove the O-ring from the inner diameter of the clutch piston.

MVC_772F

Figure 82. Piston Ring and O-Ring Removal

Disassembly of GP Control Valve with Electronic Interface

The GP Valve is made up of a non serviceable electronic interface, and two valve bodies with plugs and cartridges. O-ring kits are available for servicing the plugs and cartridges, however none of the cartridges are field serviceable beyond replacement of the o-rings. The later version (Assembly 1021658) of the hydraulic pressure regulator valve is serviceable, and contains an orifice/ filter plug, and a ball check valve assembly that are replaceable.

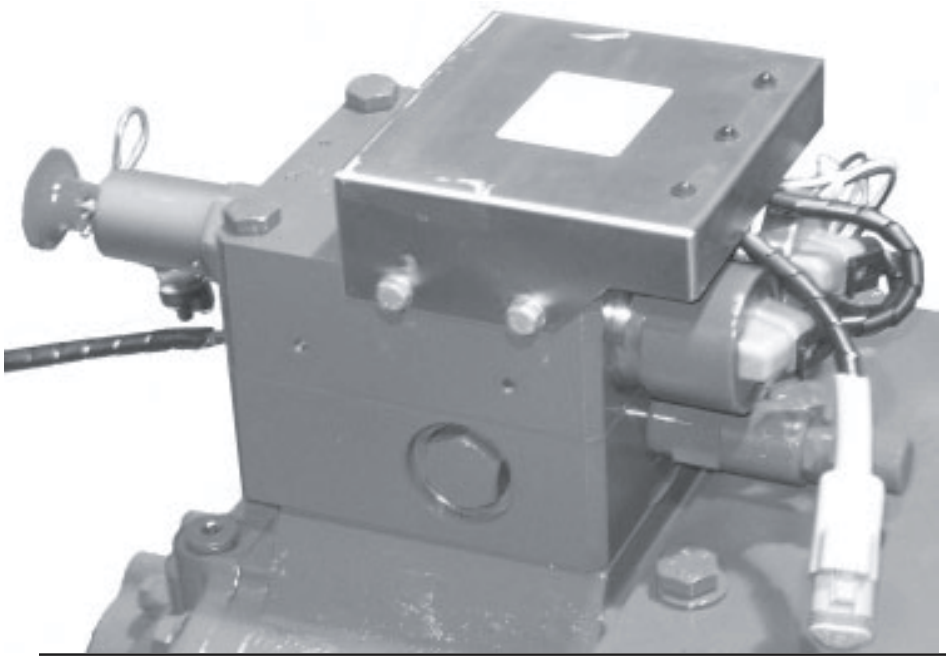


Figure 83. GP Valve Assembly Mounted on Marine Transmission

Disassembly

1. Disconnect the connectors at the proportional valves, the neutral switch, and the temperature sensor (if equipped), and loosen the four M6-1.0 capscrews that retain the Electronic Interface Module to the Hydraulic portion of the valve assembly. If the Electronic Interface is not being replaced, it can be set aside without disconnecting the remaining wires from the installation.

Figure 84. Electronic Profile Module (typical)

2. Remove the six M10-1.50 x 70 capscrews that retain the top valve body assembly to the transmission, and remove the top valve body assembly with gasket (if not previously removed).

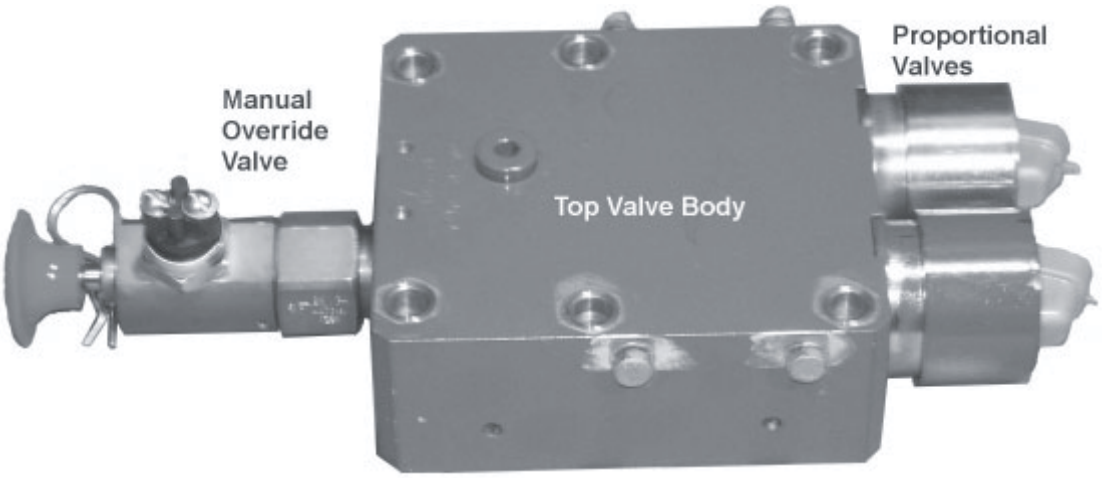


Figure 85. Top Hydraulic Valve Body Assembly

3. Remove the four capscrews that retain the main regulator valve assembly to the transmission housing or ditch plate, and remove the valve assembly and gasket.

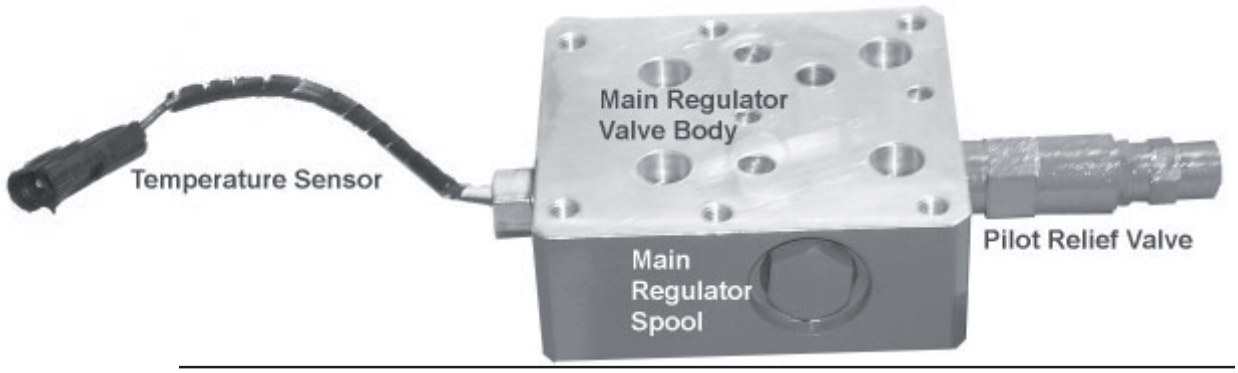


Figure 86. Main Regulator Hydraulic Valve Assembly (1020729)

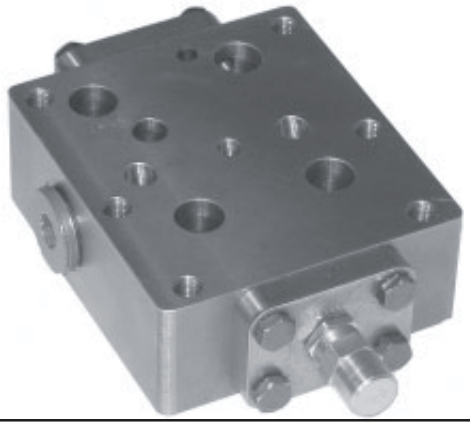


Figure 87. Main Regulator Hydraulic Valve Assembly (1021658)

4. Remove the manual direction control valve with switch or the plug assembly from the top valve body.

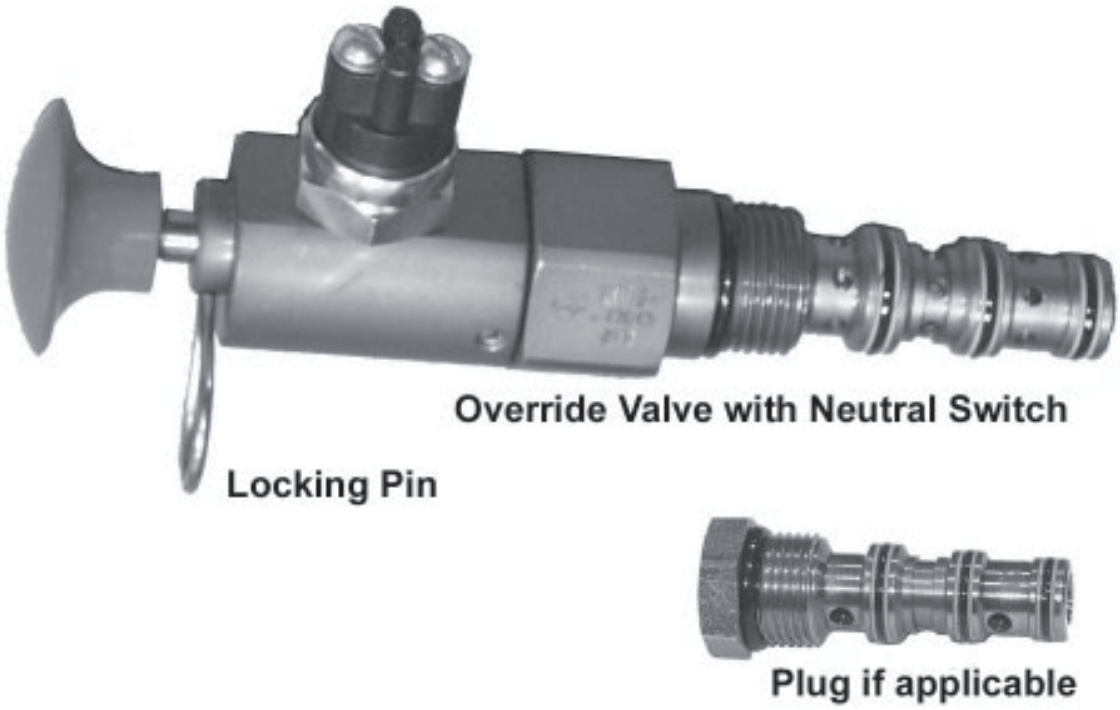


Figure 88. Manual Direction Control Valve or Plug

5. Remove the M6-1.00 x 16 Allen head capscrew, the retaining plate, and the proportional valve cartridges from the top valve body. A slight rotating motion while pulling will help to with the removal of the valves.

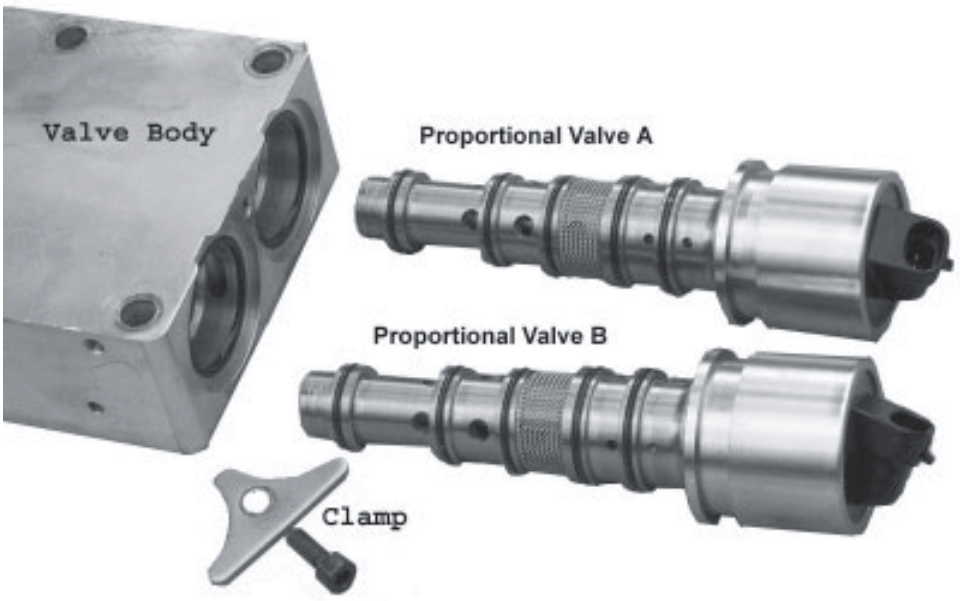


Figure 89. Remove Proportional Valve Cartridges

6. **Valve Assembly 1020729:** Remove the main pressure regulator pilot relief valve and main valve from the main regulator valve body.

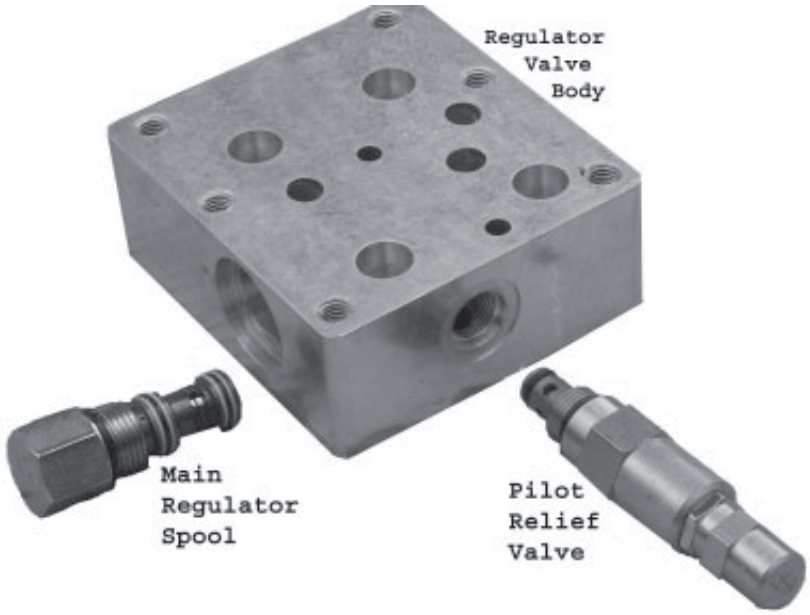


Figure 90. Remove Main Pressure Regulator Valve Components

7. **Valve Assembly 1021658:** Remove the main pressure regulator from the main regulator valve body.

   a. Remove the regulator adjusting screw cap, and loosen the jam nut.

   b. Turn the adjusting screw counter clockwise to reduce the spring load on the valve.

   c. Evenly loosen the four M-8 x 25 capscrews, and remove the cover assembly and gasket, followed by the spring(s) and spool.

   d. Remove the four M-8 x 20 capscrews, and remove the cover and gasket.

   e. Remove the orifice and screen assembly for cleaning.

   f. Remove the ball check assembly only if necessary. Removal will require destruction and replacement of the assembly.

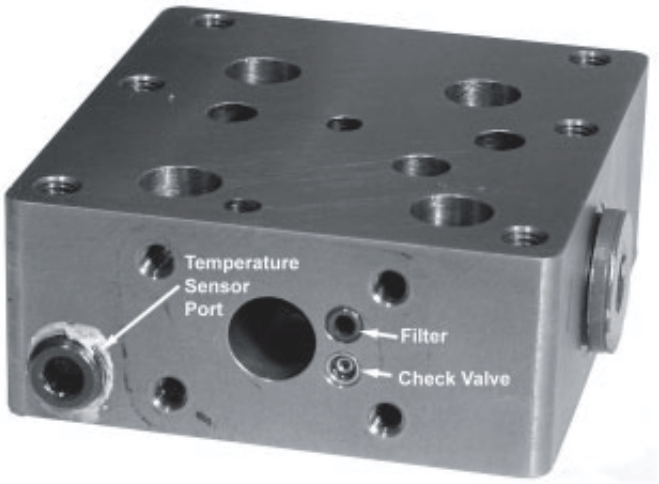


Figure 91. Remove Main Pressure Regulator Valve Components

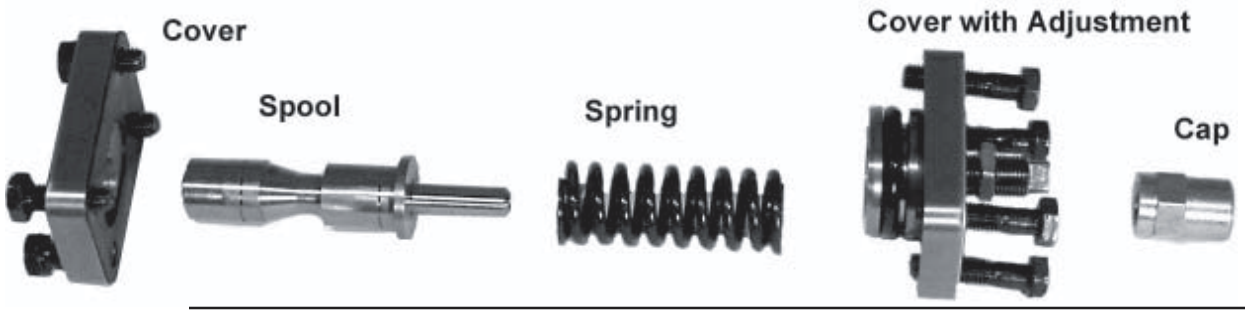


Figure 92. Remove Main Pressure Regulator Valve Components

NOTES

Cleaning and Inspection

Cleaning

Note: Replace all oil seals, gaskets, O-rings piston rings, seal rings, snap rings, etc., as a part of any maintenance or overhaul procedure. Replace shims that are damaged or destroyed in disassembly.

- ❑ Clean all parts using EPA/OSHA approved solvents or by steam cleaning. Parts must be dried and oiled immediately to prevent corrosion.
- ❑ Examine all parts carefully for grit, dirt and abrasives and reclean them if necessary.
- ❑ Clean all oil passages by working a piece of wire back and forth through the passages and then flushing them with cleaning solvent.
- ❑ Use clean solvent to flush oil pumps, valves, etc.
- ❑ Flush all hoses, tubing, coolers etc., particularly if the unit is being disassembled because of an internal failure.
- ❑ De-burr the housing and bearing carrier with a stone or file in the vicinity of all pusher screw locations.

Cleaning Bearings

DO NOT remove grease in which new bearings are packed. Thoroughly wash bearings that have been in service. Soak bearings in solvent if they are particularly dirty or filled with hardened grease.

⚠ CAUTION

Never dry bearings with compressed air. Do not spin unlubricated bearings. Oil bearings with SAE 10 engine oil immediately after cleaning. Oil bearings before inspection.

Preventing Dirt from Entering into Bearings

Dirt and grit in bearings are often responsible for bearing failure; consequently, it is important to keep bearings clean. Do not remove grease from new bearings. Keep the wrapper on new bearings until they are installed. Do not expose clean bearings if they are not to be assembled at once. Wrap them with a clean lint-free cloth or paper to keep out dust.

Previously Sealed Joints

- ❑ For previously sealed joints, scrape surfaces to remove old gasket material or Loctite® sealant.
- ❑ Clean surfaces with solvent to remove oil and grease residue.
- ❑ Test for clean surfaces by applying a few drops of cool water to the surfaces. Parts are sufficiently clean if water covers the surface in a film. If the water puddles or forms beads, use fresh solvent and reclean.

Inspection

Housings, Cast Parts, and Machined Surfaces

- ❑ Replace cast parts or housings that are cracked.
- ❑ Inspect bores for wear, grooves, scratches and dirt. Remove burrs and scratches with crocus cloth or soft stone. Replace deeply grooved or scratched parts. Do not remove excess material by sanding or grinding. This will cause loss of fit of bearings or races.
- ❑ Inspect oil passages for obstructions. If you find an obstruction, remove it with compressed air or work a wire back and forth through the passage and flush it with solvent.
- ❑ Inspect machined surfaces for burrs, scratches, nicks and foreign matter. If you cannot remove the defect with crocus cloth or a soft stone, replace the part.
- ❑ Inspect ground tapers for scratches, galling or scoring damage. If any of these are present, replace the part.
- ❑ Inspect ground tapers for burrs or nicks. If you cannot remove the defect with a soft stone, replace the part.
- ❑ Inspect threaded openings for damaged threads. Chase damaged threads with a tap of the correct size.
- ❑ Inspect studs for damaged threads and looseness. Replace defective studs.
- ❑ Inspect dowel pins for wear or damage. Replace defective dowels.
- ❑ Inspect dowel pin holes for wear due to movement between mating parts. If a dowel pin hole is worn, re-bore and sleeve the hole when possible. Otherwise, replace the parts. This applies where a matched set of parts is not involved.

Valve Seats

Inspect valve seats for burrs, nicks and scratches. If you cannot remove these defects with a crocus cloth, replace the part. Check to see that the valve is seating properly after reworking the valve seat.

Bearings

- ❑ Inspect bearings for roughness of rotation. Replace the bearing if the rotation is rough.
- ❑ Inspect bearings for corrosion, and for indication of wear of balls or rollers. Inspect for scored, scratched, cracked, pitted or chipped races. If you find one of these defects, replace the bearing.
- ❑ Inspect bearing bores and shafts for grooved, burred, or galled conditions that would indicate the bearing has been turning in its housing or on its shaft. If you cannot repair the damage with a crocus cloth, replace the part.

Bushings and Sleeves

Inspect bushings for size and out-of-roundness. Inspect for scores, burrs, sharp edges, and evidence of overheating. Remove scores with a crocus cloth. If the bushing is out-of-round, deeply scored, or excessively worn, replace it.

Thrust Washers and Spacers

Inspect thrust washers for distortion, scores, burrs and wear. Rework or replace any defective thrust washers or spacers.

Gears

- ❑ Inspect gears for scuffed, nicked, burred or broken teeth. If you cannot remove the defect with a soft stone, replace the gear.
- ❑ Inspect gear teeth for wear that may have destroyed the original tooth shape. If you find this condition, replace the gear.
- ❑ Inspect thrust faces of gears for scores, scratches and burrs. If you cannot remove these defects with a soft stone, replace the gear.

Splined Parts

Inspect splined parts for stripped, twisted, chipped or burred splines. Remove burrs with a soft stone. Replace the part if other defects are found.

Springs

Inspect springs for broken or distorted coils. Replace the spring if either of these defects is found.

Flexible Hoses

Inspect all flexible hoses for cracks and sponginess. Replace damaged hoses.

Clutch Plates

Inspect clutch plates for signs of overheating, pitting, or excessive wear of the friction and splined surfaces. Replace the clutch plates if one of these defects is found. Refer to wear limits in Description and Specifications.

NOTES

Assembly

General

Note: Photos are intended to illustrate the procedure and may not be consistent with previous assembly steps.

During service of this unit, all O-rings, gaskets and seals **must be** replaced.

Refer to cleaning and inspection information in this manual prior to assembly. It is good practice to compare the new parts with those being replaced during the assembly process (to make sure you don't mistake the quantity or size).

Flat washers are used under all fasteners where the head of the fastener contacts an aluminum surface.

Unless otherwise specified, all torque values listed are for capscrews that have been lubricated on the threads and contact surfaces.

Pipe threads called out as PT (British Standard Pipe Taper) on drawings and in this text are different from NPT threads. PT threads and NPT threads are NOT interchangeable. Adapters are available from several manufacturers to convert PT threads to NPT threads.

Where grease is specified, use a lithium based grease (NLGI 2).

Submerge all new clutch friction plates in clean transmission oil for a minimum of one hour prior to installation.

This transmission uses liquid sealer in many locations. The approved sealant is Loctite® 518 (MA1015), applied per S774 (a thin layer of sealant is all that is required), with Loctite® Primer N (MA1012). Avoid getting sealant into the O-ring counter bores.

This transmission uses thread lockers MA908 and MA1007 at specified capscrew locations.

Note: In the discussion that follows, the input side of the transmission is the front and the output side is the rear. Left and right sides are determined by facing from the rear toward the front.

⚠ CAUTION

Appropriate eye protection must be worn during transmission assembly. To avoid personal injury, proper safety equipment must be used during installation of any heated bushings, bearings and other components.

Prior to Assembly - Output End Bearings

Note: Special Tools, Ground Bearing Cups: Prior to using these cups for measuring end play, place the unit's cup onto the appropriate bearing cone and measure the total length of the bearing. Place the special grind cup onto the same bearing cone and measure the total length of the bearing. Note the difference in the two measurements for the end play calculation. Repeat for each bearing cup that is used for setting end play.

Rear Primary Bearing:

Bearing height w/original cup O = _____

Bearing height w/ground cup G = _____

Difference D = O - G _____

Rear Secondary Bearing

Bearing height w/original cup O = _____

Bearing height w/ground cup G = _____

Difference D = O - G _____

Rear Output Bearing

Bearing height w/original cup O = _____

Bearing height w/ground cup G = _____

Difference D = O - G _____

Primary Shaft Assembly

1. If removed, install a new rear taper bearing cone on the output end of the shaft.

   a. Heat the bearing cone to 120°C (250°F).

⚠ WARNING

Handle the bearing cone with care. The bearing cone is HOT.

   b. Place the bearing cone on the clutch shaft and push it firmly into position against the clutch housing.

   Note: Be sure to seat the bearing cone against the clutch housing as the bearing cools.

2. Install the clutch piston into the clutch housing.

   a. Lubricate and install a new piston ring on the outside diameter of the clutch piston.

   b. Lubricate and install a new piston ring on the small area sealing surface of the clutch piston.

   c. Lubricate and install a new O-ring in the inside diameter of the clutch piston.

   d. Install the clutch piston into the clutch housing.

   Note: If the clutch piston is difficult to install by hand, remove the clutch piston and inspect the piston rings.

MVC_772F

Figure 93. Piston Rings and O-Ring Installation

3. Position the primary clutch shaft under a hydraulic press.

   a. Slide the release spring over the shaft.

   b. Place the spring retainer on the release spring.

   c. Use Special Tool T-18502 to compress the release spring far enough to expose the snap ring groove in the shaft.

   d. Install the snap ring.

MG_054

MG_053

Figure 94. Release Spring, Spring Retainer and Snap Ring Installation

4. Install the clutch plates as follows: Install a friction (faced) plate and alternate with steel and friction plates until the 9 steel and 10 friction plates are installed, finishing with a friction plate.

MG_052

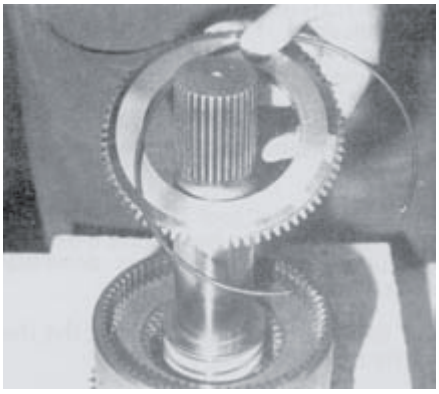
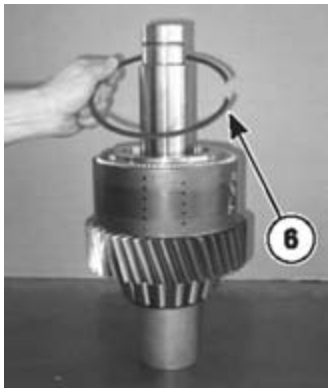

DCP_2001

Figure 95. Clutch Plates Installation

5. Install the clutch back plate (5). Press the back plate firmly into the clutch housing to ensure the splines of the clutch are aligned.

6. Place the internal snap (6) ring next to the clutch back plate.



AAR6557-069 AAR6557-1012

Figure 96. Clutch Back Plate (5) and Internal Snap Ring (6)

7. Adjust the clutch pack clearance as follows:

   a. Install the plug in the center of the shaft where “S” valve would go.

   b. Install a hose clamp over the shaft next to the bearing to block the 8 mm (0.315 in.) sump passage in the shaft.

   c. Place the shaft vertically with the backplate at the top of the clutch assembly.

   d. Apply a load of 100-200 N (23-45 lbf) to the backplate.

   e. Using a dial indicator, zero the bottom position for the backplate. Apply air pressure to the clutch apply hole located between the seal ring grooves at the shaft end.

   f. Observe the measurement of the clutch clearance on the dial indicator.

      Clutch clearance must be between 2.30-3.20 mm (0.091-0.126 in.). If clutch clearance is out of specified range, shim clutch using steel plates 2.34-2.38 mm (0.092-0.094 in.) thick, friction plates 3.07-3.20 mm (0.121-0.126 in.) thick or cores from friction plates 1.54-1.57 mm (0.061-0.062 in.) thick.

When shimming using friction or core plates, the addition plate must be located between the backplate and last active friction plate. When shimming using a steel plate, the additional plate must be located between the last active friction and steel plates.

g. Record the final clutch clearance.

8. Install the front thrust bearing onto the input shaft in this order: thrust washer (pilots on shaft) with recessed bore over the snap ring, needle bearing, and thrust washer (pilots in bore of pinion).

DCP_1048

Figure 97. Installing Front Thrust Needle Bearing and Thrust Washers

9. Lubricate the area of the clutch shaft that will contact the pinion assembly. Install the pinion assembly. Gently rotate the pinion as it is lowered into the clutch plates until the splines are fully engaged in all the clutch plates.

DCP_1046

Figure 98. Pinion Assembly Installation

10. Install the thrust washer into the pinion bore.

11. Install the front needle bearing.

Note: The snap ring retainer serves as the thrust washer on the primary shaft.

DCP_1045

Figure 99. Front Thrust Washers and Needle Bearing Installation

12. Install the snap ring to retain the front needle bearing, thrust washer, and pinion.

DCP_1043

Figure 100. Snap Ring Installation

Secondary Shaft Assembly

1. If removed, install a new rear taper bearing cone on the output end of the shaft.

   a. Heat the bearing cone to 120°C (250°F).

⚠ WARNING
Handle the bearing cone with care. The bearing cone is HOT.

   b. Place the bearing cone on the clutch shaft and push it firmly into position against the clutch housing.

   Note: Be sure to seat the bearing cone against the clutch housing as the bearing cools.

2. Install the clutch piston into the clutch housing.

   a. Lubricate and install a new piston ring on the outside diameter of the clutch piston.

   b. Lubricate and install a new piston ring on the small area sealing surface of the clutch piston.

   c. Lubricate and install a new O-ring in the inside diameter of the clutch piston.

   d. Install the clutch piston into the clutch housing.

   Note: If the clutch piston is difficult to install by hand, remove the clutch piston and inspect the piston rings.

MVC_772F

Figure 101. Piston Rings and Installation

3. Position the secondary clutch shaft under a hydraulic press.

   a. Slide the release spring over the shaft.

   b. Place the spring retainer on the release spring.

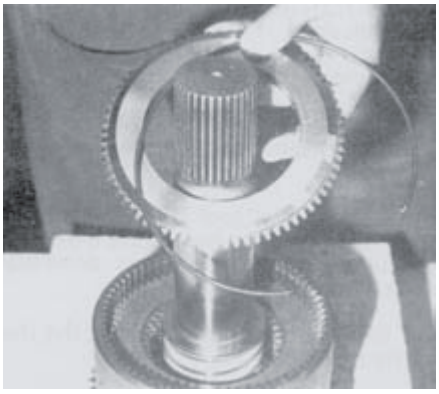
   c. Use Special Tool T-18502 to compress the release spring far enough to expose the snap ring groove in the shaft.

   d. Install the snap ring.

MG_054 MG_053

Figure 102. Release Spring, Spring Retainer and Snap Ring Installation

4. Install the clutch plates as follows: Install a friction (faced) plate and alternate with steel and friction plates until the 9 steel and 10 friction plates are installed, finishing with a friction plate.

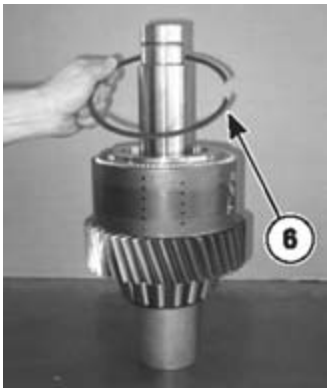


MG_052 DCP_2001

Figure 103. Clutch Plates Installation

5. Install the clutch back plate (5). Press the back plate firmly into the clutch housing to ensure the splines of the clutch are aligned.

6. Place the internal snap (6) ring next to the clutch back plate.



AAR6557-069 AAR6557-1012

Figure 104. Clutch Back Plate (5) and Internal Snap Ring (6)

7. Adjust clutch pack clearance as follow:

   a. Temporarily instal the pump drive adapter using two M8-1.25 x 20 mm socket head screws.

   b. Install a hose clamp over the shaft next to the bearing to block the 8 mm (0.315 in.) sump passage in the shaft.

   c. Place the shaft vertically with the backplate at the top of the clutch assembly.

   d. Apply a load of 100-200 N (23-45 lbf) to the backplate.

   e. Using a dial indicator, zero the bottom position for the backplate. Apply air pressure to the clutch apply hole located between the seal ring grooves at the shaft end.

   f. Observe the measurement of the clutch clearance on the dial indicator.

      Clutch clearance must be between 2.30-3.20 mm (0.091-0.126 in.). If clutch clearance is out of specified range, shim clutch using steel plates 2.34-2.38 mm (0.092-0.094 in.) thick, friction plates 3.07-3.20 mm (0.121-0.126 in.) thick or cores from friction plates 1.54-1.57 mm (0.061-0.062 in.) thick.

When shimming using friction or core plates, the addition plate must be located between the backplate and last active friction plate. When shimming using a steel plate, the additional plates must be located between the last active friction and steel plates.

g. Record the final clutch clearance.

8. Install the front thrust bearing onto the input shaft in this order: thrust washer (with recessed bore over the snap ring), needle bearing, and thrust washer.

5135_0286

Figure 105. Installing Front Thrust Needle Bearing and Thrust Washers

9. Lubricate the area of the clutch shaft that will contact the pinion assembly. Install the pinion assembly. Gently rotate the pinion as it is lowered into the clutch plates until the splines are fully engaged in all the clutch plates.

5135_0283

Figure 106. Pinion Assembly Installation

10. Install the larger diameter thrust washer into the pinion bore.

11. Install the front needle bearing and remaining rear thrust washer.

    Note: This thrust washer pilots on the shaft.

5135_0281

Figure 107. Front Thrust Washers and Needle Bearing Installation

12. Install the snap ring to retain the front thrust washers and needle bearing and pinion.

Main Housing Assembly

1. If removed, install new clutch shaft input end outer bearing cups in the main housing.

    a. Deep freeze the bearing cup to -51°C (-60°F) for at least two hours before installing it.

⚠ WARNING
Handle the bearing cup with care. The bearing cup is extremely COLD.

    b. Lubricate the bearing bore in the main housing.

    c. Install the bearing cup into the main housing. Be sure the bearing cup is bottomed in the bore as the bearing cup warms to the ambient temperature.

2. If removed, install a new output shaft bearing cup in the main housing.

    a. Deep freeze the bearing cup to -51°C (-60°F) for at least two hours before installing it.

⚠ WARNING
Handle the bearing cup with care. The bearing cup is extremely COLD.

    b. Lubricate the bearing bore in the main housing.

    c. Install the bearing cup into the main housing. Be sure the bearing cup is bottomed in the bore as the bearing cup warms to the ambient temperature.

3. Install a new input shaft seal.

    a. Apply MA1015 sealer to the outside diameter of a new input shaft seal.

    b. Press the seal into the housing using Special Tool TD-300492. Lip of seal should face away from the main housing when installed and rear of seal should be flush with the rear of the front housing bore.

Output Gear and Output Shaft Assembly

Note: To ensure the correct assembly of the output shaft into the output gear, the advancement of the shaft into the gear must be measured. The advancement is the distance the shaft will be pressed into the gear after metal to metal contact is made after placing the shaft into the gear by hand.

1. Clean and inspect the output gear tapered bore.

   a. Prepare the gear tapered bore surface for assembly by using a Scotchbrite® pad to remove any burrs.

   b. Clean the shaft tapered surface and the gear bore with an appropriate solvent. Dry the shaft and clear all oil passages in the shaft with compressed air.

⚠ CAUTION

If the gear or shaft is damaged and cannot be repaired without material removal, replace the part.

⚠ CAUTION

The tapered surface of the shaft and matching tapered gear bore must be completely free of grease, oil dirt and solvent residue. Failure to properly clean mating parts could prevent proper advance of the gear on the shaft and adversely affect torque carrying capacity of the assembled joint.

2. Place the output shaft into the output gear and seat with a force of 445-890 N (100-200 lbf).

3. Measure from the end of the shaft to the shoulder of the shaft. Measure three locations around the shaft. The three readings should be identical. Record this distance as Dimension A.

4. Measure from the end of the shaft to the face of the output gear. Measure three locations around the shaft. The three readings should be identical. Record this distance and Dimension B.

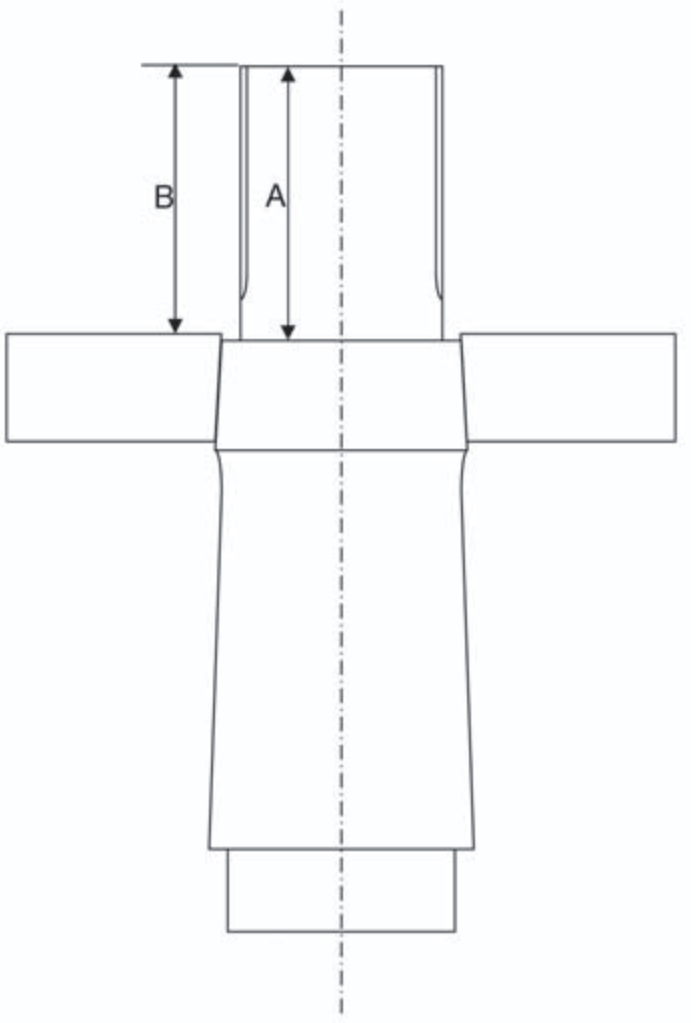


Figure 108. Measuring Output Gear and Shaft Advancement

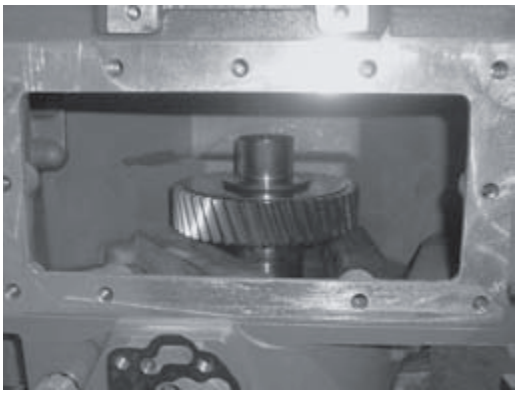
5. Subtract Dimension B from Dimension A to determine advancement. The advancement should be:

   3.81 mm (0.150 in.) to 5.33 mm (0.210 in.) for all ratios.

6. Remove the output gear from the output shaft.

7. Position the main housing with the output end down. Be sure the main housing is securely supported. Place two wooden blocks inside the main housing and slide the output gear into the housing on the blocks. Be sure the large end of the tapered bore is down.

8. Carefully lower the main housing with gear onto the output shaft, resting the weight of the gear on the taper of the output shaft.



100_1271

Figure 109. Output Gear on Output Shaft in Main Housing

9. Place output gear advance tool over the end of the output shaft and center it. Temporarily retain the tool with a special retaining bolt, 1/4 - 19 BSP threaded bolt and washer.

   Note: It will be necessary to fabricate this special bolt.

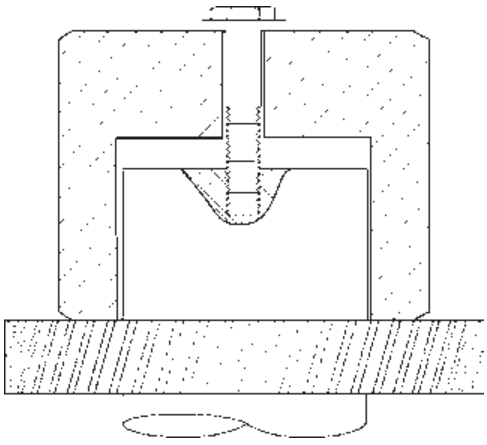


Figure 110. Output Gear Advance Tool Secured to Output Shaft

10. Place assembly into a press, supporting the output shaft end on the press. Block the main housing for stability.

100_1269 100_1266

Figure 111. Main Housing with Output Gear in Press

11. Remove the 1/4 - 19 BSP special retaining bolt.

12. Use output gear advance tool to press the output gear onto the output shaft. Use the force shown in the following chart:

Ratio	Static Press Force
2.90:1, 2.57:1, 2.04:1	500-706 kN (51.0-72.0 metric tons)
1.73:1	451-628 kN (31.7-45.8 metric tons)
1.48:1, 1.28	383-529 kN (39-55 metric tons)
1.10:1, 1.00:1	500-706 kN (51-72 metric tons)

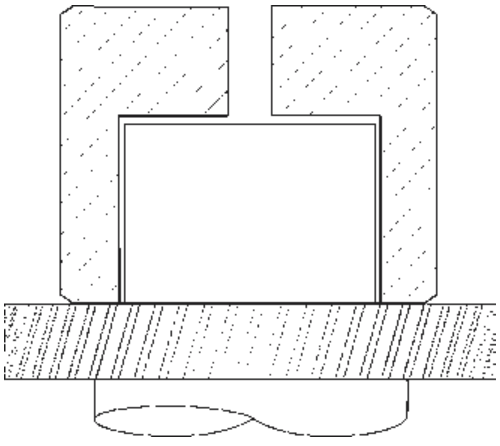


Figure 112. Pressing Output Gear Onto Output Shaft

13. Remove the output gear advance tool.

14. Check the output gear advance. The face of the gear should be flush with the shoulder on the shaft within 0.05 mm (0.002 in.).

15. Heat the front bearing to 120°C (250°F) for 30 minutes and press on output shaft until it is seated. Be sure it is properly seated.

⚠ CAUTION

Handle the front bearing with care. The front bearing is HOT.

16. Carefully remove assembly from the press and place it on the output end of the output shaft. Lower the assembly until the blocking can be removed.

17. Insert the gear pan into the main housing and rotate it around approximately in place. Lower the assembly until the front output bearing is in place in its outer race.

18. Block the gear with wooden blocking material to hold the front bearing cone in its race. Turn the housing over with the input end down. Block the unit securely.

19. Heat the rear output bearing cone to 120°C (250°F) for 30 minutes and install on the shaft. Be sure it is properly seated. A sleeve with a plate and the three capscrews can be used to seat the bearing against the shaft shoulder.

⚠ CAUTION

Handle the rear bearing with care. The rear bearing is HOT.

20. Install the special output bearing ground cup onto the bearing cone. Temporarily install the output seal carrier using four of the M12 capscrews.

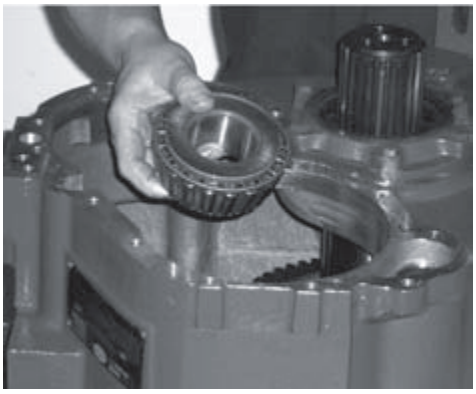
21. Install capscrews and sealing washers to secure the gear pan. Torque the M8 capscrews to 23 N•m (17 lb•ft).

Front Bearings

Note: Position the main housing with input end down. Be sure the main housing is securely supported.

1. Lubricate and install the primary clutch shaft front bearing.

2. Lubricate and install the secondary clutch shaft front bearing.



383_5135

Figure 113. Primary and Secondary Front Bearings Installation

Install Secondary and Primary Clutch Shafts

1. Install an eyebolt into the end of the secondary clutch shaft.

Note: When servicing a 1:1 ratio transmission, it is necessary to remove or install both the primary and secondary clutch shaft assemblies at the same time.

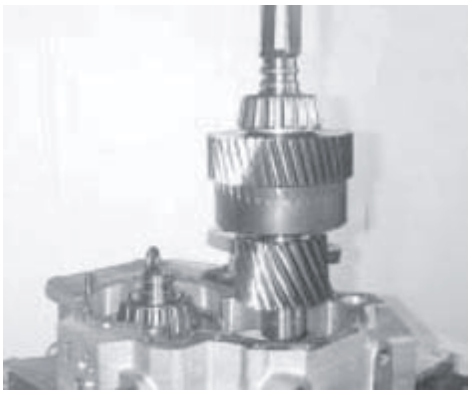
1_to_1_ spacer

Figure 114. Primary and Secondary Clutch Shaft Installation - 1:1 Ratio Transmissions

2. Lubricate the input end of the secondary shaft.

3. Use a hoist to install the secondary clutch shaft in the main housing. Be sure the snap ring retainer is on the shaft. Use grease to hold it in place, if necessary.

4. Remove the eyebolt.



5135_0628

Figure 115. Secondary Clutch Shaft Installation

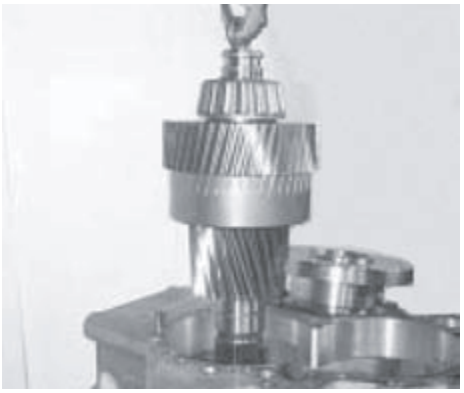
Install Primary Clutch Shaft

1. Install an eyebolt into the output end of the primary clutch shaft.

2. Lubricate the input end of the shaft.

3. Use a hoist to install the primary clutch shaft in the main housing. Be sure the snap ring retainer thrust washer is on the shaft. Use grease to hold it if necessary.

4. Remove the eyebolt.



5135_0629

Figure 116. Primary Clutch Shaft Installation

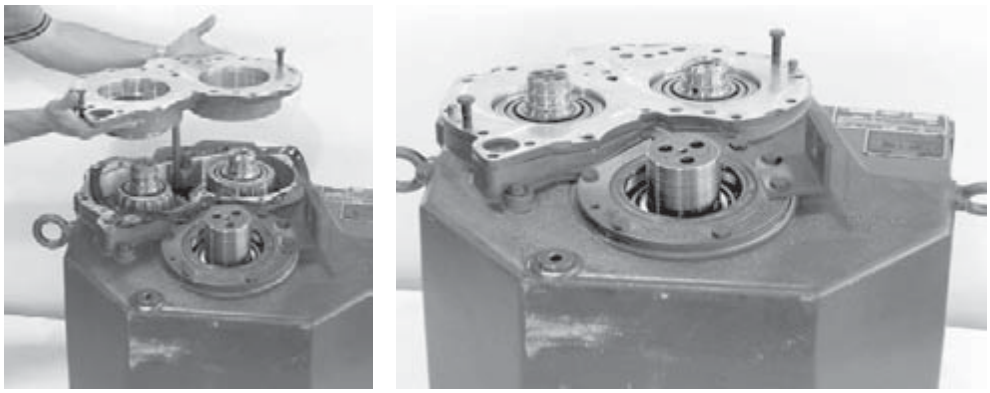
Rear Bearing Carrier

1. Place the Special Ground Bearing Cups into the bearing carrier.

2. Assemble and install the lube relief valve to the rear bearing carrier. Torque the two M8-1.25 x 16 capscrews with washers to 23 Nm (17 lb-ft.).

3. Using a new gasket, place the rear bearing carrier on the main housing.

4. Install the appropriate spacer in each bearing carrier bore.



DCP_1023 DCP_1022

Figure 117. Rear Bearing Carrier with Special Ground Bearing Cups

Bearing Preload Measurement and Shimming

Note: Place the transmission on the front housing. Be sure the transmission is securely supported.

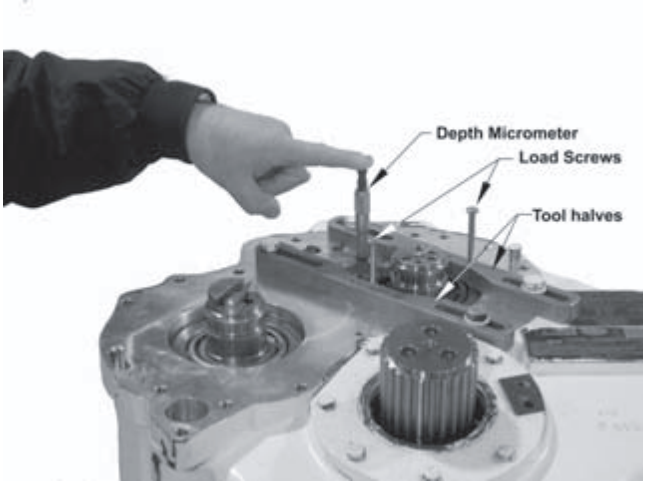
General

There are two means of measuring the shaft end play to determine the appropriate amount of shims necessary to obtain the required shaft bearing preload. One method is to measure the shaft movement while using a dial indicator and the other method is to use a depth micrometer to calculate the clearance available for shims. Both methods require the use of a Special Ground Bearing Cup. Due to limited access through the manifold opening, the depth micrometer measurement may be the desireable method on this transmission.

1. Install two Special Tools, TD-21552-101or equivalent tool, at the primary shaft with the two 1/4 - 20 threaded rods or screws to load the bearing cup.

   a. Locate the two tool halves such that a load can be applied to the bearing cup in two locations 180° apart.

   b. Clamp the tools to the housing using the appropriate capscrews with washers. Torque the capscrews to the standard torque valve as shown in Description and Specifications.



MG_311

Figure 118. Special Tools TD-21552-101

2. Apply 10 lb•in. of torque to the load screw to apply a force to the rear of the bearing cup and rotate shaft three complete turns. Repeat torquing 10 lb•in. followed by rotating the shaft until the applied torque remains on the screws.

3. Measure the depth from the housing rear to the rear of the bearing cup and note measurements.

4. Repeat steps 1 through 3 for the secondary shaft.

5. Repeate steps 1 through 3 for the output shaft except torque the load screws to 30 lb•in.

6. Measure the thickness of the gasket and record this dimension.

Primary Shaft

Housing rear to rear of bearing cup = A _____

Thickness of gasket = B _____

Desired preload = C _____

Bearing height (orginal cup) – Bearing height (ground cup) = D _____

Shimpack needed (including spacer) = A + B + C + D = _____

Secondary Shaft

Housing rear to rear of bearing cup = A _____

Thickness of gasket = B _____

Desired preload = C _____

Bearing height (orginal cup) – Bearing height (ground cup) = D _____

Shimpack (including spacer) needed = A + B + C + D = _____

Output Shaft

Housing rear to rear of shim spacer = A _____

Thickness of gasket (adjusted for crush) = B _____

Desired preload = C _____

Bearing height (orginal cup) – Bearing height (ground cup) = D _____

Shimpack needed = A + B + C + D = _____

9. Remove the Special Ground Bearing Cups from the three shaft locations.

Rear Bearing Cups

1. Install a new output bearing cup in the housing.

   a. Deep freeze the bearing cup to -51°C (-60°F) for at least two hours before installing it.

⚠ WARNING

Handle the bearing cup with care. The bearing cup is extremely COLD.

   b. Lubricate the bore of the housing.

   c. Use a bearing installation tool to install the bearing cup into the housing.

2. Install a new output shaft seal in the seal carrier.

   a. Apply MA1015 sealer to the outside of the new output shaft seal.

   b. Use a seal installation tool to install the seal into the carrier. Lip of the seal must face away from the seal carrier.

3. Install a new O-ring in the pilot diameter groove.

   a. Coat the O-ring with grease.

   b. Install the O-ring in the groove.

4. Install the output shaft seal carrier to the main housing.

   a. Place the previously selected shims and seal carrier on the main housing.

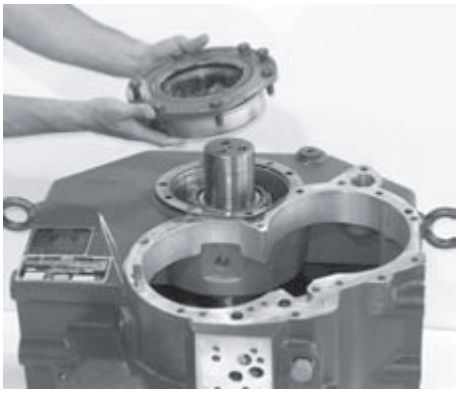


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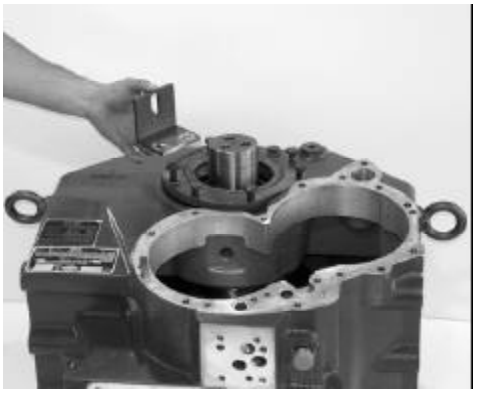
Figure 119. Output Shaft Seal Carrier Installation

b. Install the output speed sensor pickup bracket, if equipped.



DCP_1037

Figure 120. Output Speed Sensor Pickup Bracket Installation

c. Secure the seal carrier. Torque the M12 - 1.25 capscrews to 80 N•m (59 lb•ft).

5. Install new clutch shaft bearing cups in the rear bearing carrier.

a. Deep freeze the bearing cup to -51°C (-60°F) for at least two hours before installing it.

⚠ WARNING

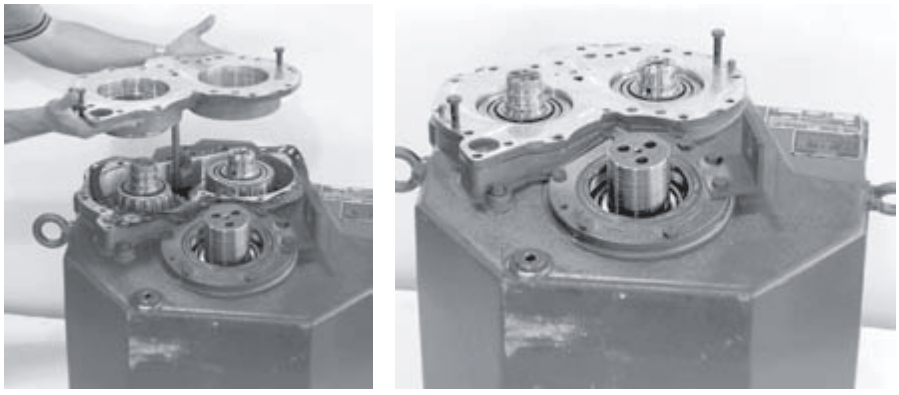
Handle the bearing cup with care. The bearing cup is extremely COLD.

b. Lubricate the bore of the rear bearing carrier.

c. Use a bearing installation tool to install the bearing cups into the rear bearing carrier.

6. Assemble and install the lube relief valve to the rear bearing carrier. Torque the two M8-1.25 x 16 capscrews with washers to 23 Nm (17 lb-ft).

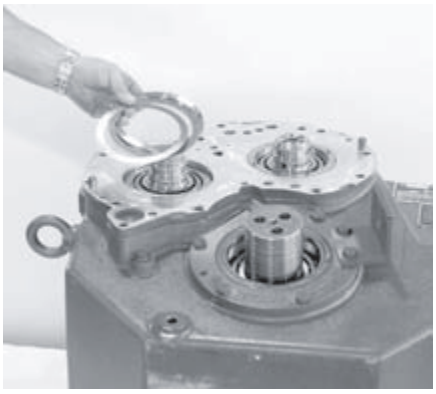
7. Place the gasket and rear bearing carrier on the main housing. Install and align the lube tube if it was removed from the bearing carrier.



DCP_1023 DCP_1022

Figure 121. Rear Bearing Carrier Installation

8. Install the bearing spacers and shim packs as determined by measurement.



DCP_1020

Figure 122. Bearing Spacers and Shim Pack Installation

9. Install the “S” valve into the primary clutch shaft.

   a. Calibrate the “S” valve following the procedure shown in Special Tools Section.

   b. Lubricate and install the external O-ring.

   c. Install the “S” valve into the bore in the output end of the clutch shaft.

   d. Install the spacer. Note that the primary shaft spacer is shorter than the secondary clutch shaft spacer.

   e. Apply Loctite® 242 to the threads of the plug. Torque the plug to 12 N•m (9 lb•ft).

10. Install the “S” valve into the secondary clutch shaft.

   a. Calibrate the “S” valve following the procedures shown in Special Tools Section.

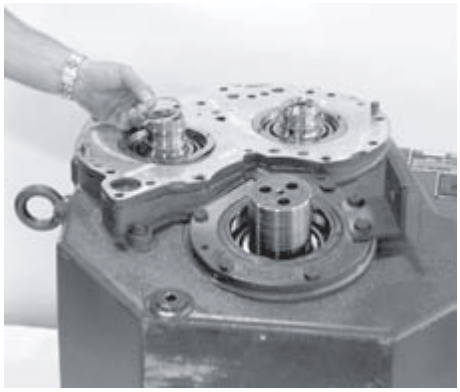
   b. Lubricate and install the external O-ring.

   c. Install the “S” valve into the bore in the output end of the clutch shaft.

   d. Install spacer. Note that the secondary shaft spacer is longer than the primary shaft spacer.

   e. Install the pump drive adapter and torque the two M8-1.25 x 20 socket head capscrews to33 N•m (23.5 lb•ft).

11. Install the piston rings in the grooves at the end of the primary and secondary clutch shafts.



DCP_1019

Figure 123. Piston Ring Installation

Manifold

1. If removed, install a new primary clutch shaft bushing in the manifold.

   a. Install a new O-ring into the groove in the mandifold.

   b. Use two 10-24 UNC threaded rods to align the screw holes in the manifold with the holes in the bushing.

   c. Deep freeze the bushings to -51°C (-60°F) for at least two hours before installing them. Use a bearing installation tool to install the bushing into the manifold.

⚠ WARNING
Handle the bushings with care. The bushings are extremely COLD.

d. Apply Loctite® 518 (MA 1015) to the threads of the two 10-24 UNC x 5.8 flat head screws. Use a bushing installation tool to install the bushing into the manifold.

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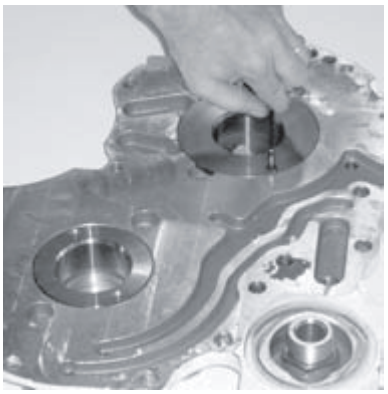
5135_0253

Figure 124. Primary Clutch Shaft Manifold Bushing Installation

2. If removed, install a new secondary clutch shaft bushing in the manifold.

   a. Use two 10-24 UNC threaded rods to align the screw holes in the manifold with the holes in the bushing.

   b. Deep freeze the bushings to -51°C (-60°F) for at least two hours before installing them. Use a bushing installation tool to install the bushing into the manifold.

⚠ WARNING
Handle the bushings with care. The bushings are extremely COLD.

c. Apply Loctite® 518 (MA1015) to the threads of the two 10-24 UNC x 5/8 flat head screws. Install the flat head screws and torque to 4.5 N•m (40 lb•in).

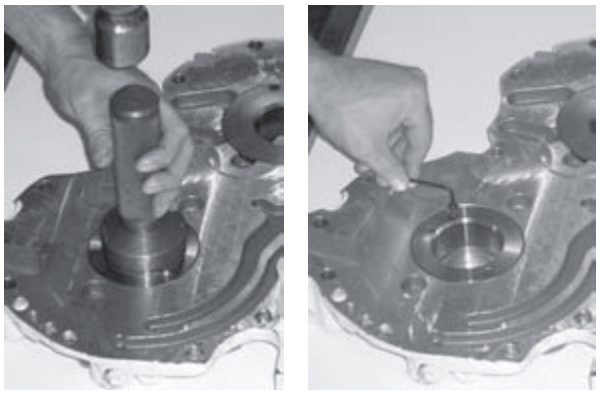

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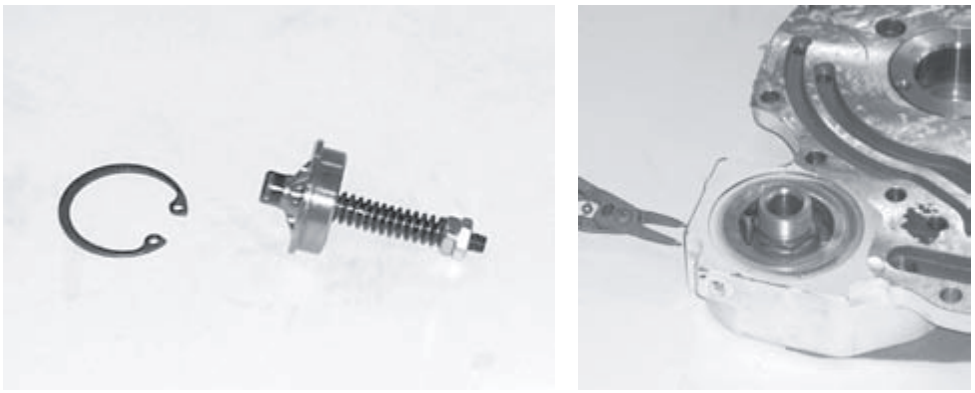
Figure 125. Secondary Clutch Shaft Manifold Bushing Installation

3. Install the filter bypass valve in the manifold. Secure the filter bypass valve in position with the retaining ring.

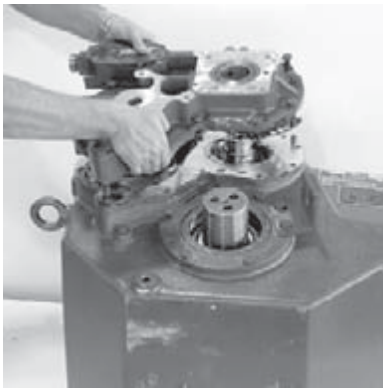


5135_0261 5135_0259

Figure 126. Filter Bypass Installation

4. Place the manifold gasket on the rear bearing carrier.

5. Position the manifold on its gasket. Align roll pin and shim pack with clearance cavity in manifold. Torque the capscrews to 46 N•m (34 lb•ft).


DCP_1017

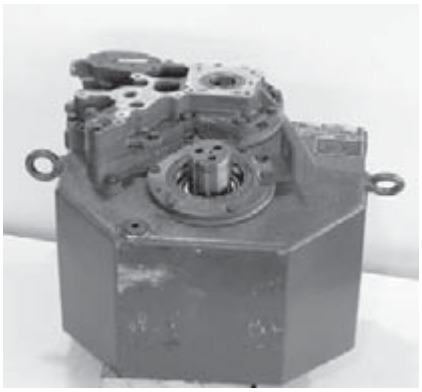

DCP1014

Figure 127. Manifold Installation

Output Flange

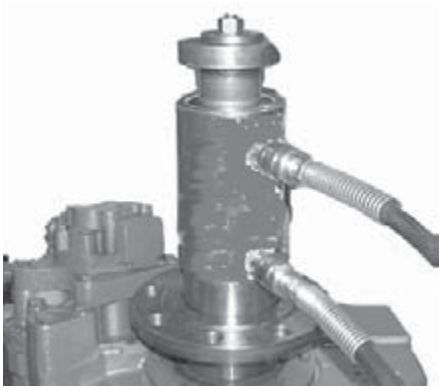
Note: Prior to installation of the output flange, install the v-ring on the output flange with the thin wiper away from the flange face.

1. Heat the output flange to 120°C (250°F) for 30 minutes. Assemble the flange on the output shaft. Take care not to damage the oil seal when engaging the flange.

⚠ CAUTION

Handle the output flange with care. The output flange is HOT.

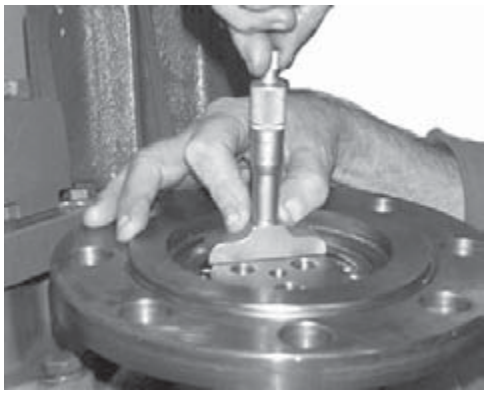
2. The flange can also be installed by the aid of a special tool TD-300389. Bolt the special tool washer to the output flange and install a hydraulic ram. Use the ram to push the flange onto the shaft.



Output flange 1

Figure 128. Output Flange Installation

3. Measure the gap from the shoulder of the output flange on which the retainer washer rests on to the end of the output shaft.



Output flange 4

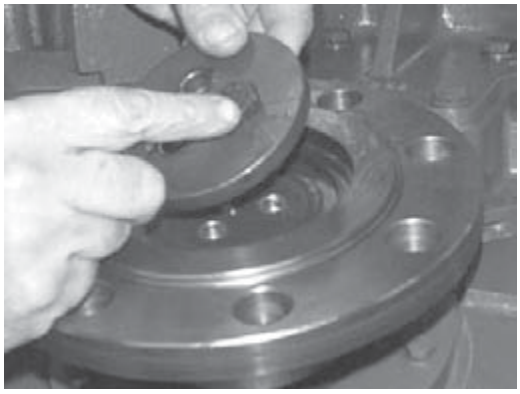
Figure 129. Measure Output Flange For Shims

4. Add shims that are 0.075 - 0.150 mm (0.003 - 0.005 in.) thinner than the gap. Install the rectangular rubber washer and retainer washer.

Output flange 2

Figure 130. Output Flange Shim Installation

5. Install output flange clamp plate. Apply Loctite® 242 to the three M12 x 40 capscrews and torque to 80 N•m (59 lb•ft).



Output flange 3

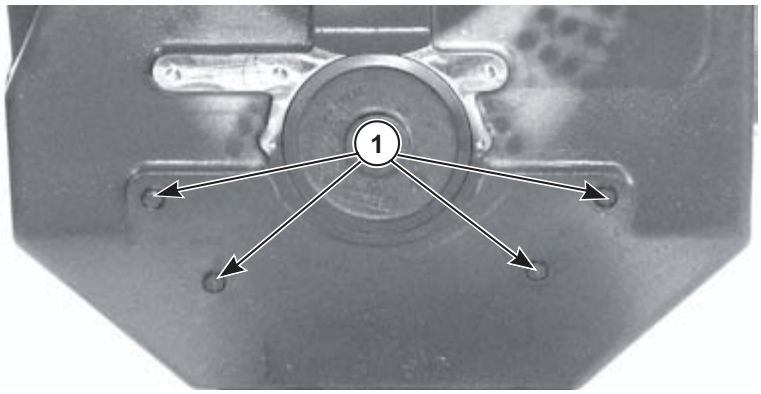
Figure 131. Output Flange Clamp Plate Installation

Install External Components

Output Gear Pan

Note: Place the main housing in the upright position. Be sure the main housing is securely supported.

1. Place new seal washers on the four M8 output gear pan capscrews (1).
2. Torque the capscrews to 23 N•m (18 lb•ft).



DCP_1031_4

Figure 132. Securing Output Gear Pan

Front Output Cover

1. Lubricate a new O-ring with grease.
2. Install the O-ring onto the cover.
3. Press the cover (1) into bore of the main housing.

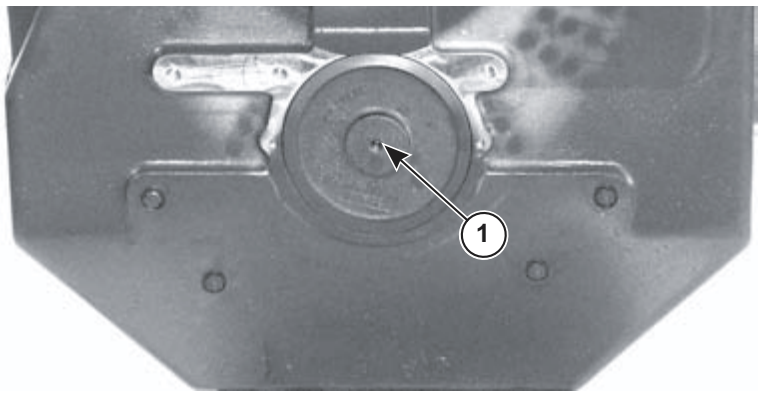


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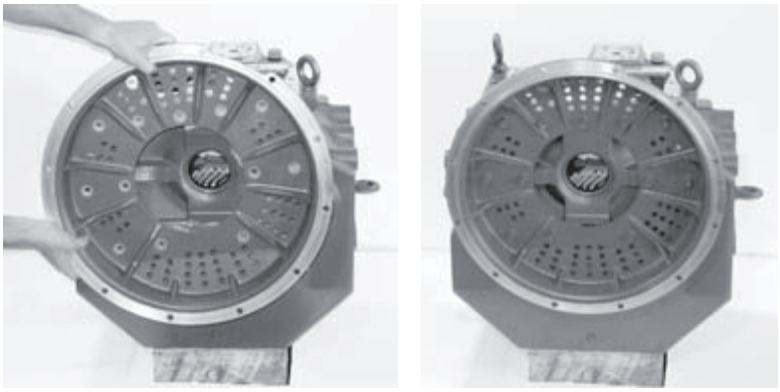
Figure 133. Front Output Cover (1) Installation

Input Housing

1. Position the input housing on the main housing.

2. Secure the input housing wiht twelve M12-1.75 capscrews and washers. Torque the capscrews to 80 N•m (59 lb•ft).



DCP_1030 DCP_1029

Figure 134. Input Housing Installation

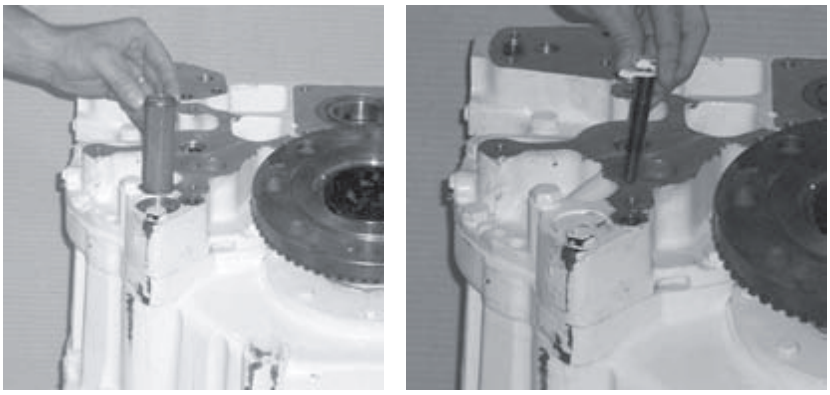
Suction strainer

1. Place the suction strainer in the manifold. Install an O-ring on the clamp plate.

2. Secure the suction strainer with the clamp plate and capscrew and washer.

3. Torque the M12 - 1.5 capscrew to 80 N•m (59 lb•ft)

4. Torque the M12 x 90 capscrew to 80 N•m (59 lb•ft).

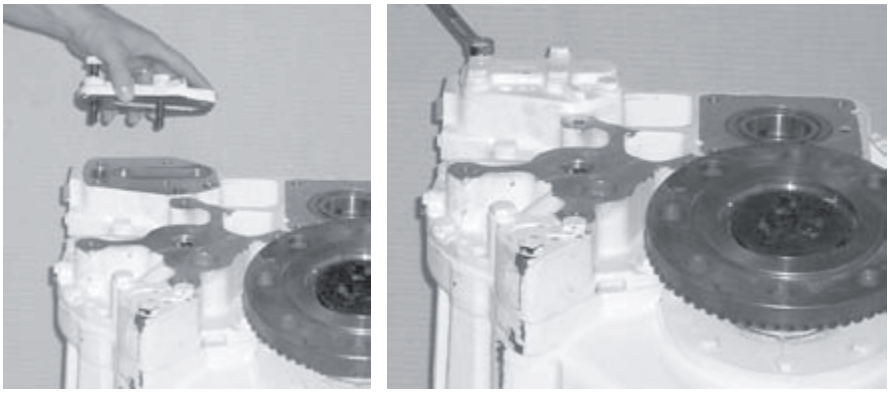


5135_0161 5135_0159

Figure 135. Suction Strainer Installation

Oil Bypass Cover

1. Apply MA1015 seal to the oil filter bypass cover.
2. Install the oil filter bypass cover.
3. Torque the four M10 x 45 capscrews to 46 N•m (34 lb•ft)
4. Torque the M12 x 90 capscrew to 80 N•m (59 lb•ft).



5135-0157 5135_0156

Figure 136. Oil Filter Bypass Cover Installation

PTO Cover

Note: Some units may have heat exchanger bracket.

1. Lubricate and install a new PTO cover O-ring.
2. Install the PTO cover or the heat exchanger bracket.

3. Torque the four M12 x 30 capscrews to 80 N•m (59 lb•ft).

5135_0155

Figure 137. PTO Cover Installation

Hydraulic Pump

1. Verify that the pump drive tang engages correctly in the slot at the end of the secondary clutch shaft.

2. Observe the index marks on the pump and the manifold made during disassembly. Install the pump and gasket following the index marks.

   Note: Verify that the pump is installed in the correct position. The position can vary depending on the engine direction of rotation. If necessary, refer to the Engineering Drawings at the end of this manual.

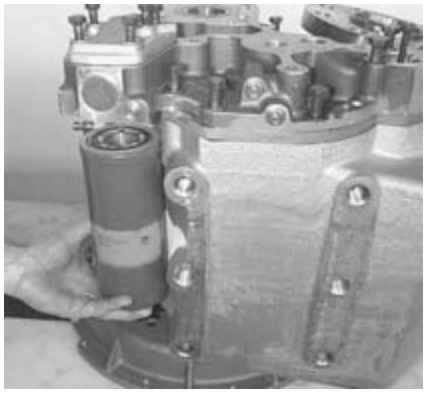
3. Torque the four M10 x 45 capscrews to 46 N•m (34 lb•ft).

5135_402

Figure 138. Hydraulic Pump Installation

Hydraulic Oil Filter

Lubricate the O-ring and install the hydraulic oil filter to the manifold.



5135_405

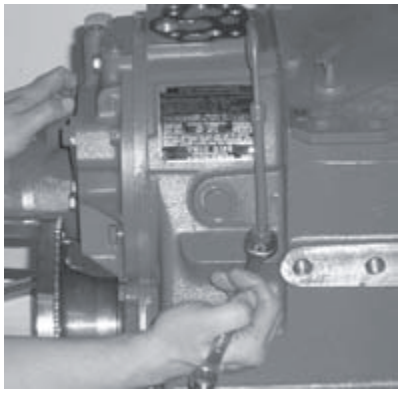
Figure 139. Hydraulic Oil Filter Installation

Dipstick Tube

1. Apply pipe thread compound to the threads and install the dipstick tube into the front housing.

2. Tighten the dipstick tube to 23 N•m (17 lb•ft).

3. Install the dipstick.



286_5135

Figure 140. Dipstick Tube Installation

Top Cover

1. Position the top cover and gasket on the transmission housing.

2. Install the eleven M12 x 30 capscrews and tighten to 80 N•m (59 lb•ft). Install one M8 x 20 capscrew with washers and tighten to 23 N•m (17 lb•ft).

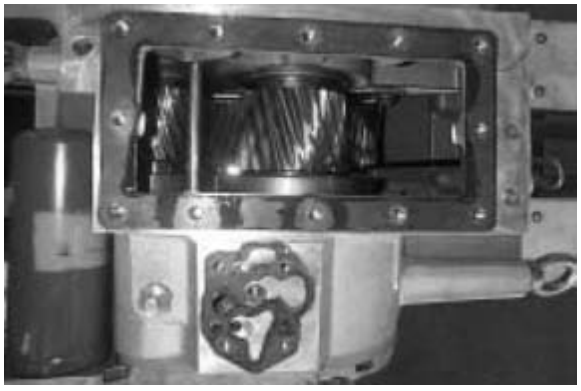


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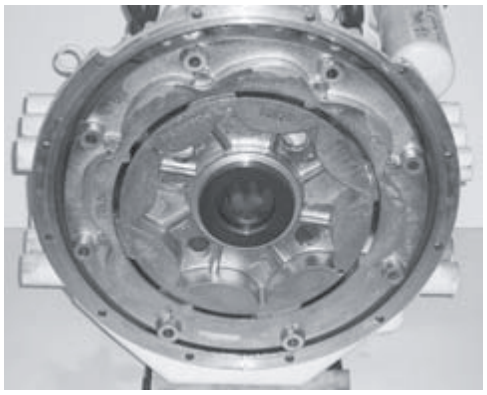
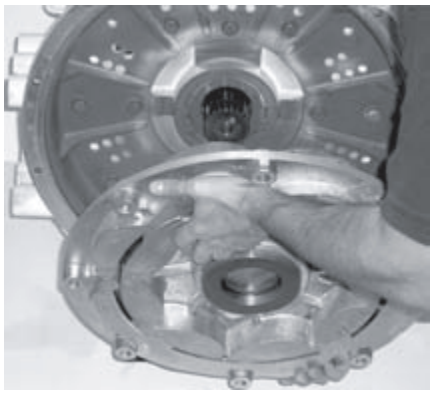
Figure 141. Top Cover Installation

Input Coupling

1. Place input coupling on input shaft.

2. Use shipping wire to secure the flywheel.

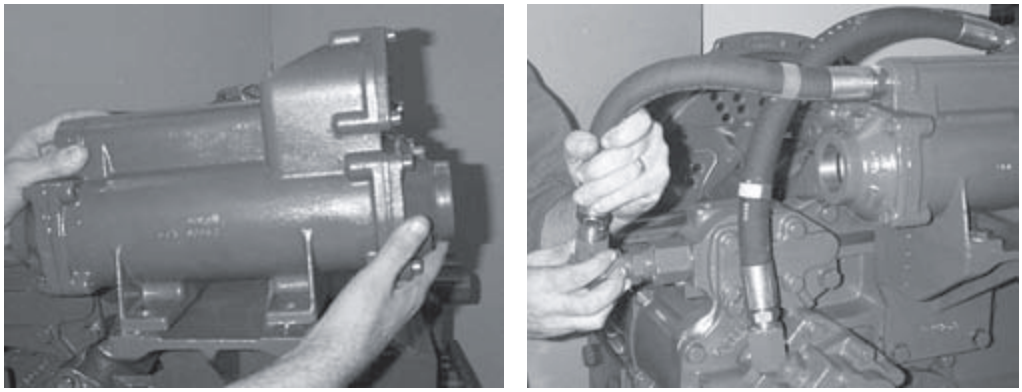
5135_0141 5135_0142

Figure 142. Input Coupling Installation

Heat Exchanger (If Equipped)

1. Install the heat exchanger. Tighten the four M10 capscrews to 46 N•m (34 lb•ft).

2. Install and tighten the heat exchanger hoses.



5135_0002 5135_0001

Figure 143. Heat Exchanger Installation

Speed Sensors (If Equipped)

1. Apply MA908 (Locktite® 242) to the threads of the output sensor (2).

2. Assemble the output speed sensor until it contacts tip of a gear tooth.

3. Back out the output sensor two full turns.

4. Secure the output sensor in place with two jam nuts.

5. Apply MA908 (Locktite® 242) to the threads of the input sensor (1).

6. Assemble the input speed sensor until it contacts tip of a gear tooth.

7. Back out the input sensor one full turn.

8. Secure the input sensor in place with two jam nuts.

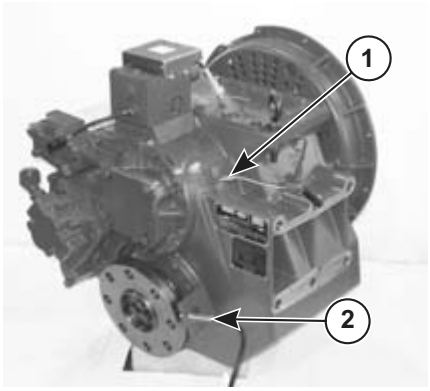


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Figure 144. Input Speed Sensor (1) and Output Speed Sensor (2) Installation

Assembly of GP Control Valve with Electronic Interface

Prior to assembly, all parts must be properly cleaned. Carefully inspect all o-rings for any damage and replace as necessary. Lubricate all o-rings, and replace both gaskets.

1. **Valve Assembly 1020729**: Assemble the Main Regulator Valve body.

    a. Install the Main Pressure pilot relief valve into the valve body and torque to 27 N•m (20 lb•ft).

    b. Install the Main Valve into the valve body and torque to 33 N•m (24 lb•ft).

    c. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 N•m (17 lb•ft).

    d. Install the M27 x 2.0 O-ring plug into the valve body and torque to 75 N•m (55 lb•ft).

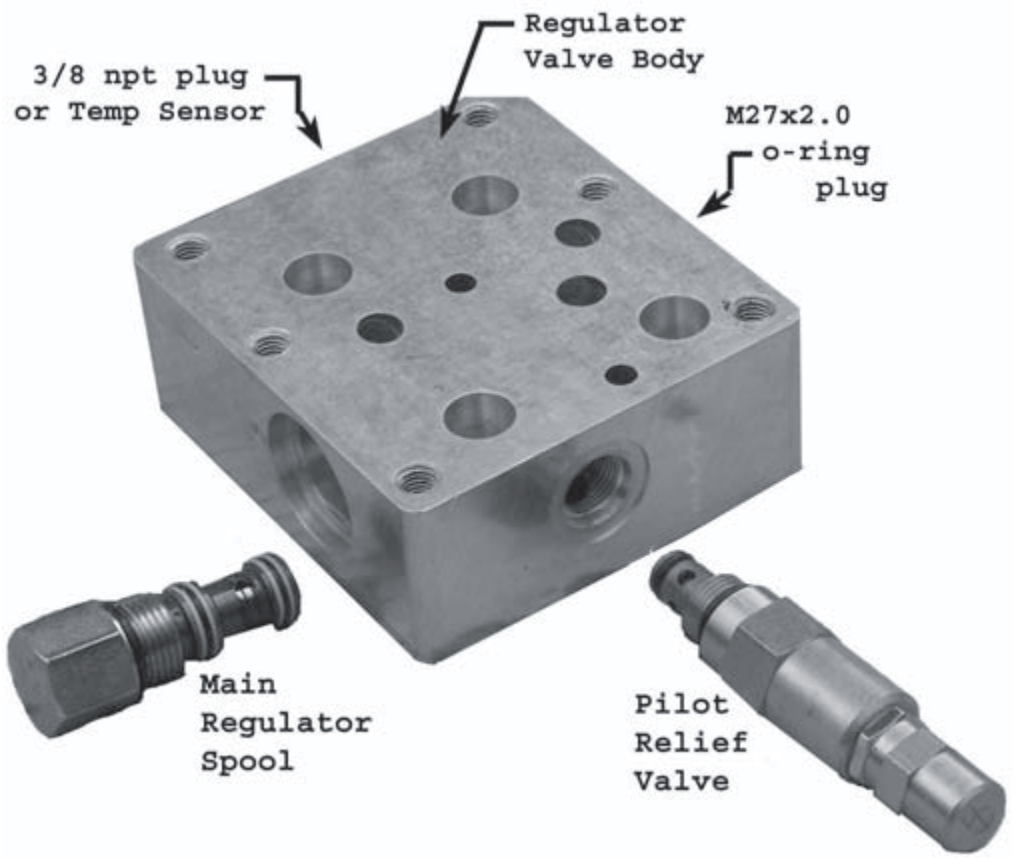


Figure 145. Main Pressure Regulator Components Assembly 1020729

1. **Valve Assembly 1021658**: Assemble the Main Regulator Valve body.

   a. Install the filter into the threaded hole of the valve body, and torque to 7.5 N•m (5.5 lb•ft). If removed, install a new check valve assembly into the bore of the valve body and drive it with a drift until it is flush with the face of the body. Install the 3/8 nptf pipe plug or optional temperature sensor into the valve body and torque to 23 N•m (17 lb•ft).

   b. Install the gasket and cover without the adjustment screw to the valve body with four M8 x 20 capscrews and torque to 23 N•m (17 lb•ft).

   c. Install the spool with washer, and spring into the bore. Install the gasket and cover with the adjustment screw, using four M8 x 25 capscrews. Evenly tighten the capscrews, and torque to 23 N•m (17 lb•ft).

   d. Install the cap onto the adjusting screw finger tight as the main pressure must be set at the time of installation or testing.

Figure 146. Assemble Main Pressure Regulator Components

2. Assemble the Top Valve Body. Install the two proportional valve assemblies into the valve body, install the retaining plate, and torque the M6-1.00 x 16 socket head capscrew to 9.5 N•m (7 lb•ft). Install the Manual Direction Control Valve into the valve body, and torque to 27 N•m (20 lb•ft). Install the M12 x 1.50 O-ring plug into the valve body and torque to 16 N•m (12 lb•ft). Connect the wires for the Neutral Switch.

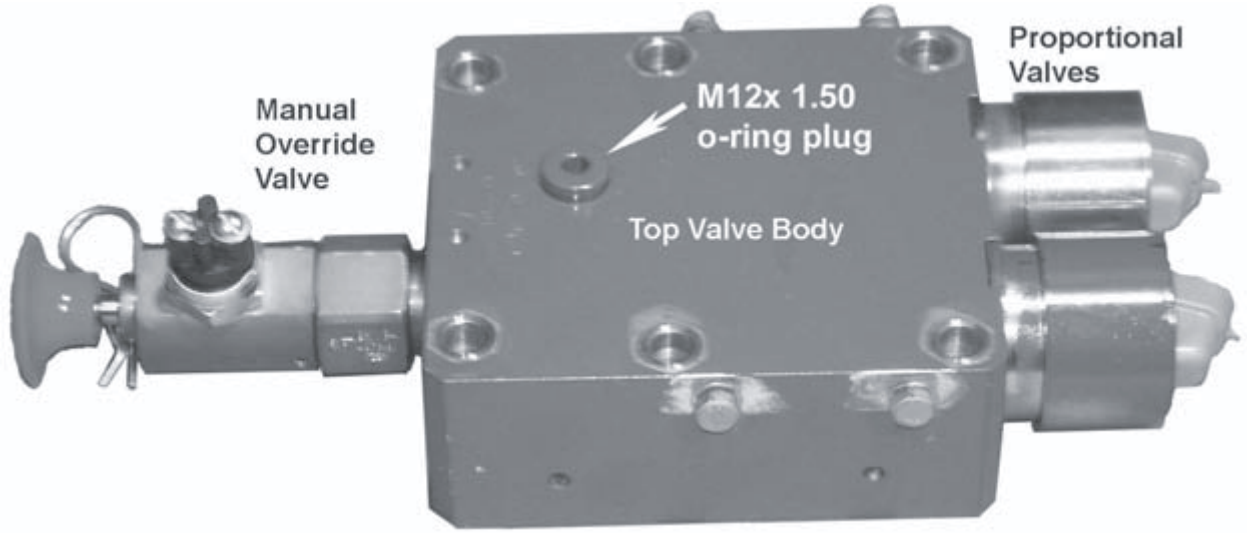


Figure 147. Assemble Top Valve Body Components

3. Install a new gasket, and the Main Regulator Valve Assembly to the transmission or ditch plate, using the four twelve point capscrews. Torque the capscrews to the level specified for the appropriate sized capscrew into aluminum threads. See the torque specifications in Description and Specifications.

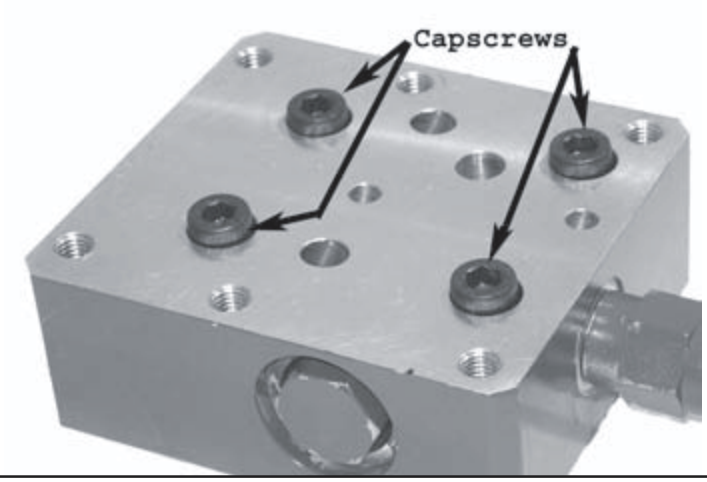


Figure 148. Install Regulator Valve Body to Transmission

4. Install a new gasket and the Top Valve Body Assembly on the Main Regulator Valve Assembly, using six M10-1.50 x 70 hex head capscrews and torque to 46 N•m (34 lb•ft).

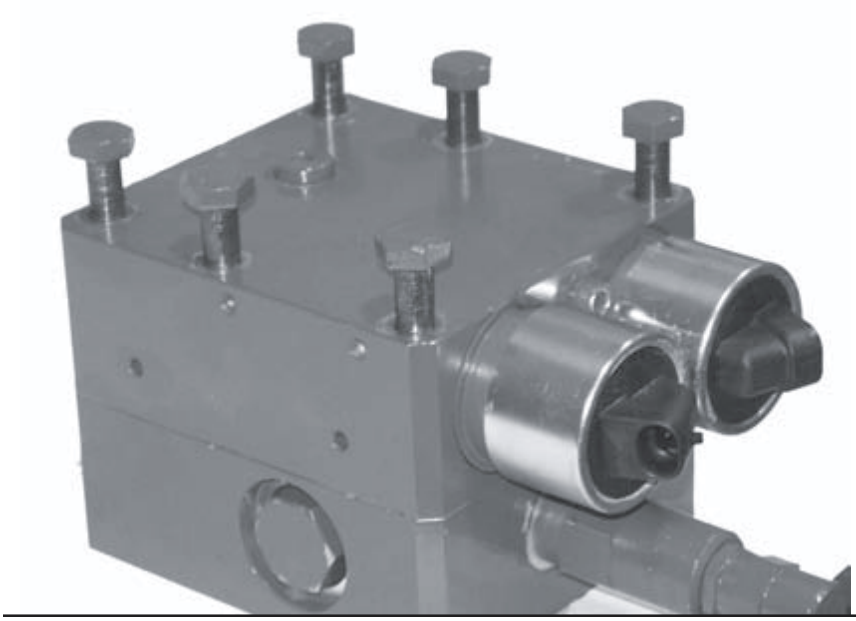


Figure 149. Install Top Valve Body onto Regulator Valve Assembly

5. Install the Electronic Profile or E-Troll Module on the top Valve Body and torque the four M6-1.0 capscrews to 9.5 N•m (7 lb•ft).

Figure 150. Place Profile or E-Troll Module onto Valve and Tighten Capscrews

6. Connect the electrical wires to the proportional valves and connect any other wires that were removed during disassembly.

Adjustment of Main Pressure

Valve Assembly 1020729: It is recommended that following the servicing of the GP Valve Assembly off of the transmission that a procedure be followed to ensure the flushing of oil through the valve assembly, followed by adjustment of the main pressure.

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the cartridge. This will expose a 1/4" hex head adjustment stem. Loosen the jam nut on the stem.

Figure 151. Pilot Relief Valve Assembly

3. Turn this adjustment stem counterclockwise until it reaches a positive stop. This allows the engine/transmission to be started and flush any debris past the relief valve.

   Note: This must be done with the transmission in Neutral.

4. Start engine with controls in neutral. Main pressure should be approximately 100 psi or less. Allow the fluid to flush the valve for approximately 1 minute.

5. Turn the 1/4" hex head adjustment stem clockwise to achieve the main pressure setting. A helpful practice is to turn the adjustment stem slightly beyond the desired setting (approximately 5 psi) and then adjust for the target pressure. This aids in reducing variance in pressure setting due to torsional wind-up of the spring.

   Note: If main pressure is to be set with cold oil, adjust the main pressure approximately 5 to 10 psi higher than the desired value with hot oil.

6. Tighten the jam nut to a torque of 20 N•m (15 lb•ft), install the protective cap and torque it to 14 N•m (10 lb•ft)

Valve Assembly 1020729:

1. Install a main pressure gauge into the port on top of the Top Valve body.

2. Remove protective cover cap located at the end of the adjusting stem. This will expose a slotted adjustment stem. Loosen the jam nut on the stem.

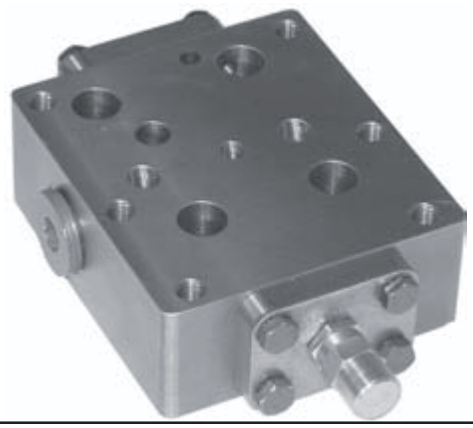


Figure 152. Main Pressure Regulating Valve Assembly 1021658

3. Start engine with controls in neutral.

   Note: This must be done with the transmission in Neutral.

4. Turn the slotted adjustment stem clockwise to achieve the main pressure setting. See the specifications in Description and Specifications.

5. Tighten the jam nut to a torque of 20 N•m (15 lb•ft), install the protective cap, and torque it to 14 N•m (10 lb•ft)

NOTES

Installation

Prior to Installation

⚠ CAUTION

Most Twin Disc products mount directly onto the flywheel of the engine, or are attached to the flywheel through external shafting or adapters. Flywheel-to-driven component interference is possible due to mismatch of components or other reasons. Therefore, engine crankshaft endplay as well as flywheel alignment checks must be made before the driven component is installed.

After installation of the driven component, the crankshaft endplay should be measured again. The endplay at the second measurement should be the same as the first. A difference in these two endplay measurements could be an indication of interference. Consequently, the driven component should be removed and the source of interference found and corrected.

Twin Disc will not be responsible for system damage caused by engine to Twin Disc component interference regardless of the cause of interference. This engine crankshaft endplay check is considered mandatory.

The transmission housing flange and pilot, the engine flywheel and the flywheel housing must be checked for trueness. Clean the engine flywheel and flywheel housing mounting surfaces thoroughly before any measurements are made.

Note: To isolate engine vibration and prevent transferring it to the hull through the propeller shaft, the distance from the marine gear output flange to a fixed stuffing box or the first fixed bearing must be a minimum of 20 times the shaft diameter. If the distance is less than this, a flexible coupling may be necessary to isolate the engine vibration.

Alignment (also reference SAE J-1033 and J-617)

1. Bolt a thousandths increment dial indicator or gauge to the engine flywheel so that the indicator is perpendicular to the face of the engine flywheel housing, and the indicator stem is riding on the face of the flange.

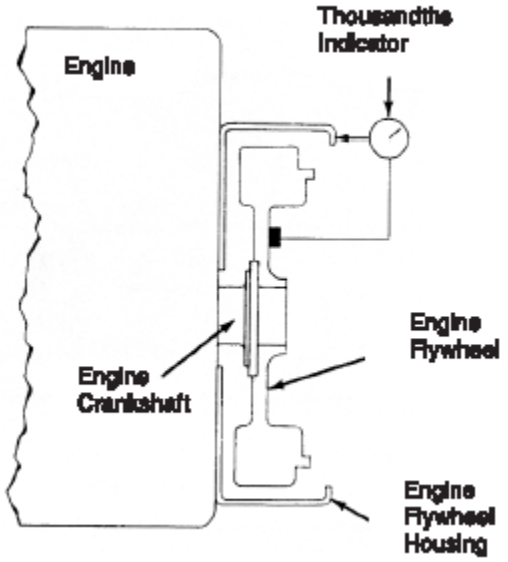


Figure 153. Checking Flywheel Housing Flange for Deviations

2. Rotate the engine flywheel, always keeping a thrust in the same direction, and note the face deviation of the engine flywheel-housing flange. The face deviation must not exceed the figures given in Table 19.

Table 19. Total Indicator Readings for Engine Flywheel Housing Flange

SAE Housing Number	Face Deviations and Bore Eccentricity mm (in.)
00	0.48 (0.019)
0	0.41 (0.016)
1/2	0.36 (0.014)
1	0.30 (0.012)
2	0.28 (0.011)

3. With the indicator mounted as in the previous paragraph, adjust the indicator stem so that it will ride on the bore of the engine flywheel housing.

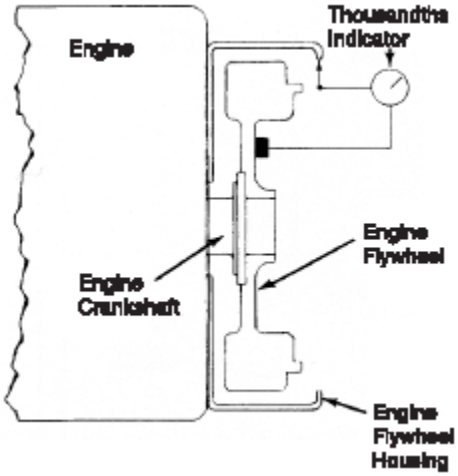


Figure 154. Checking Flywheel Housing Bore Eccentricity

4. Rotate the engine flywheel and note the bore eccentricity of the engine flywheel-housing bore. See the previous Table for allowable tolerances.

5. Bolt a thousandths dial indicator or gauge to the engine flywheel housing so that the indicator is perpendicular to the engine flywheel, and the indicator tip is riding on the inner face of the flywheel. Rotate the flywheel. The variation of the face runout of the surface to which the driving ring is bolted should not exceed 0.013 mm (0.0005 in) per inch of diameter.

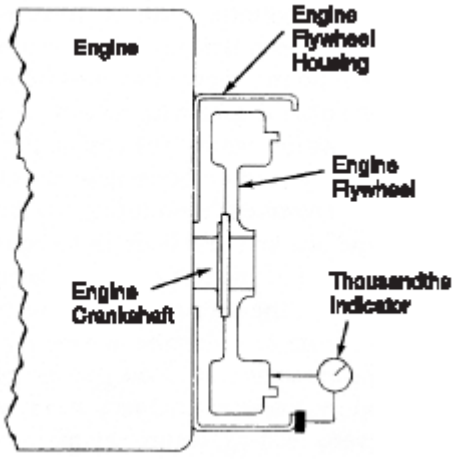


Figure 155. Checking the Flywheel Face Runout

6. With the indicator mounted as in the paragraph above, adjust the indicator tip so that it will ride on the driving ring pilot bore of the engine flywheel. Rotate the flywheel. The driving ring pilot bore eccentricity of the engine flywheel should not exceed 0.13 mm (0.005 in) maximum total indicator reading. Thrust on the flywheel should be in one direction at all times to obtain a correct reading.

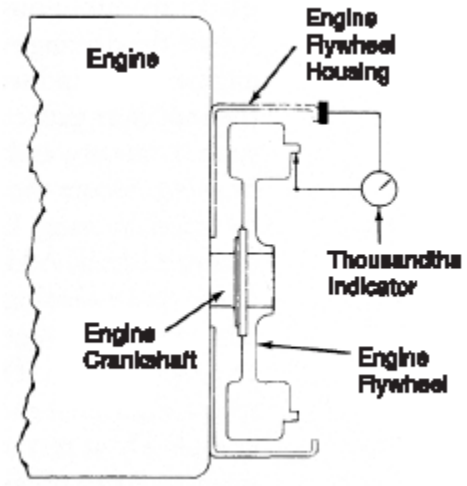


Figure 156. Checking the Flywheel Pilot Ring Bore Eccentricity

Alignment

Propeller Shaft

Before any attempt to align the engine and gearbox to the propeller shaft, proper alignment of the propeller shaft must be determined. This includes alignment of the propeller shaft through all struts and intermediate bearings. Failure to properly align the propeller shaft may result in premature wear on bearings, vibrations, or possible damage to other components.

If the length of the shaft from the last support bearing to the gearbox is excessive or a flexible stuffing box is used, the shaft must be centered prior to engine and gearbox to propeller shaft alignment.

Engine and Marine Transmission

Proper alignment of an engine and marine unit is critical, both during the initial installation and at frequent intervals during the life of the boat. It is rather common for a boat to change its form with various loads and with age. Engine and shaft alignment can also change on a boat due to varying loads and the boat's age. The following steps may be taken to secure proper marine transmission alignment.

When reinstalling a marine gear after a repair, or when installing a new marine gear to an engine already mounted in the bed rails, the flywheel housing should be checked for deflection using the following procedure:

Install the mounting brackets on the side mounting pads of the marine gear. Install the driving ring on the engine flywheel. Bolt an indicator to the engine block and set the indicator stem on the engine flywheel housing.

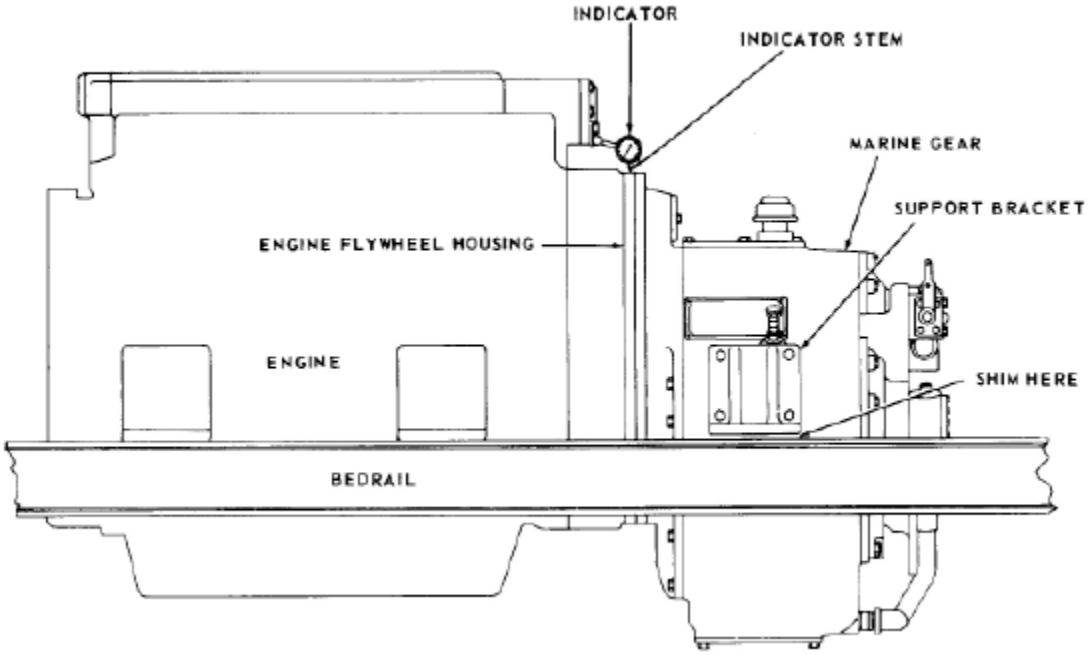


Figure 157. Marine Gear Alignment

Set the indicator gauge at zero (0). Lift the marine gear with a hoist, or other suitable means, and place the unit in position against the engine flywheel housing. Secure the flange of the marine gear main housing to the engine flywheel housing. Use a feeler gauge between each mounting bracket and engine bed rail. Add shims between the brackets and bed rails to equal the feeler gauge readings. Carefully release the lifting force on the marine gear while observing the indicator. The indicator gauge must remain steady at the zero mark. Torque the bed bolts to the proper rating. If the reading moves from zero, lift the marine gear and insert additional shims. Continue this procedure until the marine gear is completely at rest on the bed rails and the gauge maintains a steady zero reading. After obtaining the correct zero reading, indicating no distortion of the engine flywheel housing, secure the mounting brackets to the engine bed rails. Before securing the mounting brackets to the engine bed rails, the propeller shaft should be checked for alignment.

Note: The transmission output flange and companion flange bolts must be torqued to the proper value as identified in Description and Specifications.

Engine and Marine Transmission Alignment

⚠ CAUTION

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and transmission must be used. Failure to do so may result in damage to the transmission or the engine flywheel housing.

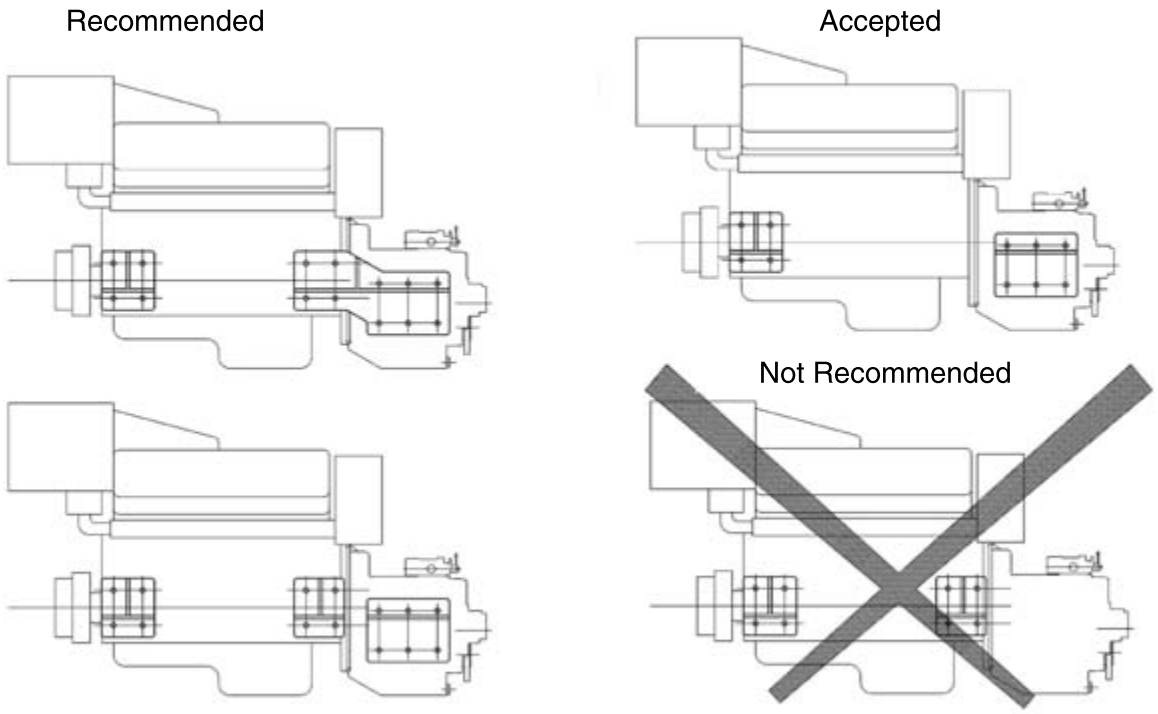


Figure 158. Transmission Mounting Configurations

When mounting the engine and transmission in the boat, all of the mounting pads on both the engine and the transmission must be used. Failure to do so may result in damage to the transmission.

It is important to align the engine and transmission only when the boat is afloat, and NOT in dry-dock. During this alignment period, it is also advisable to fill the fuel tanks and load the boat in the typical manner that it is to be used. Some boats are built with flexibility and may change shape as the loading varies. When a heavy boat is dry-docked, it naturally undergoes some bending. Therefore, it is always good practice to unbolt the marine transmission coupling to prevent bending of the shaft.

With the engine and transmission in position on the engine bed, arrangements must be made to have a controlled lifting or lowering of each of the four corners of the engine. If threaded holes are provided in each of the engine mounts, jacking screws can be used in them. The engine can be raised by screwing down, or lowered by backing off on the jacking screws to obtain the desired adjustment.

Steel plates must be inserted under the jacking screws so that the bolts will not damage the engine bed. Lifting can also be accomplished by the use of chain hoists or properly placed jacks. Adjustable shims also are available and can simplify the alignment process, particularly for future realignment.

It may also be necessary to move the engine and transmission to one side or the other on the engine bed to obtain horizontal alignment. This can be done with a jack placed horizontally between the engine and the foundation. At the same time, a straight edge is laid across the edges of the flanges at the top and side to check the parallel alignment of the coupling edges.

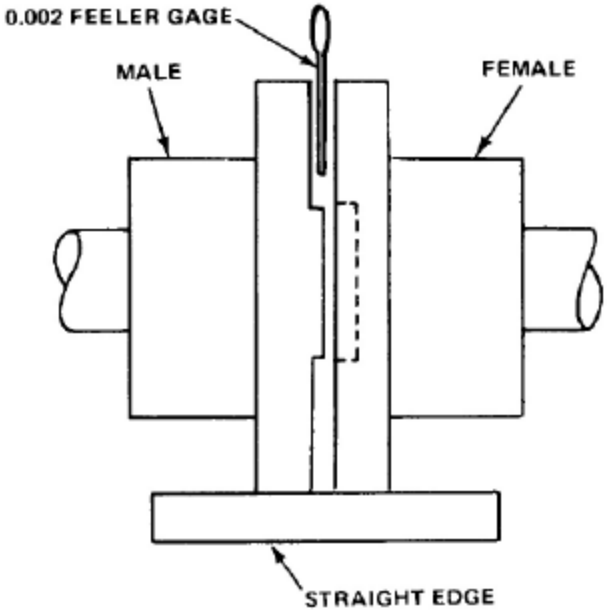


Figure 159. Checking Parallel Alignment of the Coupling

As the engine and marine transmission come into their aligned position, it will be possible to mate the output flange and propeller coupling, and prepare for bolting together. Care should be taken not to burr or mar this connection because the fit is very critical. Place a 0.05 mm (0.002 in) feeler gauge between the flanges of the coupling. Move (slide) the feeler gauge completely around the coupling. Rotate the marine transmission flange coupling in 90 degree increments, and move the feeler gauge around the flange in each successive position. The feeler gauge will fit snugly, with the same tension, all around the flange coupling in all four positions if the alignment is correct.

If the alignment varies during rotation, additional alignment is necessary, or the marine transmission and shaft couplings should be checked for proper face runout. Runout must not exceed 0.10 mm (0.004 in). Excessive face runout on the marine transmission output flange can usually be corrected by repositioning the coupling on its spline or taper. Excessive shaft coupling runout is usually due to inaccuracy of the taper fit or key to keyway interference. The optimum relative mating location will be where the measured runout dimensions of the transmission flange and the shaft coupling flange compliment each other to result in the least relative out of true parallel measurement.

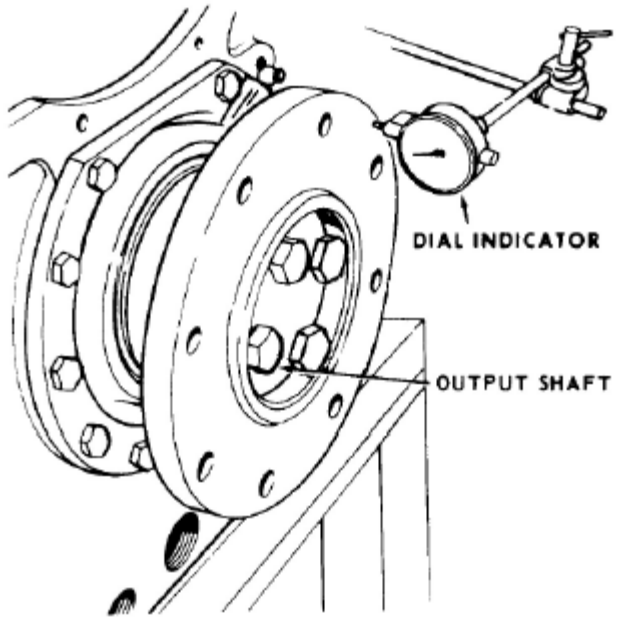


Figure 160. Checking Output Flange Face Runout

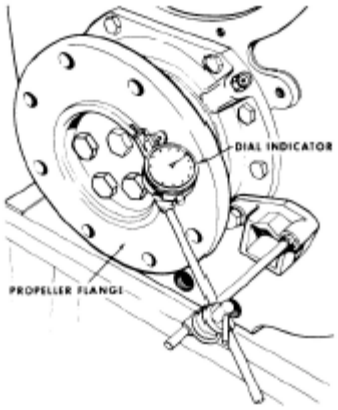


Figure 161. Checking Output Flange Pilot Eccentricity

Some boats are not structurally rigid and some carry their load in such a way that they will “hog” or go out of normal shape with every loading and unloading. Where this condition exists, it important to apply common sense alignment techniques to minimize the potential damage to any of the components.

During the process of securing final alignment, it may be necessary to shift the engine many times. When the final alignment is accomplished, mark and drill the holes for the lag studs or locating dowel pins. Then with final alignment secured, make up the necessary poured, steel, or hardwood shims, and fasten the engine and transmission in place. Then recheck the alignment, and if satisfactory, bolt the coupling together.
There are many types of flexible couplings in the market today that solve a variety of problems:

- ❑ Couplings to reduce noise and vibration.
- ❑ Couplings to allow a permanent angular misalignment.
- ❑ Couplings that allow engines to be flexibly mounted and take out the momentary misalignment.

In some cases, the proper alignment of these couplings requires an accuracy equal to that of rigid couplings. Always use the alignment procedures recommended by the coupling manufacturer.

Electrical Controls Installation

All electrical wires and connectors must be adequately supported to prevent rubbing, chafing, or distress from relative movement. All electrical connectors must be tight and free from corrosion. It is strongly recommended that the Control Harnesses and Wiring guidelines be followed to ensure proper installation of all wiring.

Control Harnesses and Wiring guidelines

Install all control wires and harnesses as follows:

1. The connector end of each control cable or harness must be secured within twelve inches of control connectors, other connectors, and all other termination points. The cable or harness must be secured to frame supports at sixteen-inch intervals along its entire length unless installed in rigid ducting or conduit.

2. Keep cable or harness away from hot surfaces, moving parts and oil locations.

3. Attach cable or harness to vessel, making the connector the highest point of the wire. If not possible, install cable or harness with drip loop.

4. Protect cable or harness with grommet, loom or flex guard at any “rub” point, particularly when passing a sheet metal hole.

5. Locate cable or harness away from potential hazards. For example, a capscrew cutting through the jacket and shorting a conductor to the chassis, welding, drilling, heat/exhaust, burrs, sharp edges, etc.

6. Prevent the cable from becoming a step or handrail.

7. Make sure connectors will mate properly. Locate and use the connector orientation key.

8. Circular connectors must be hand-tightened and lock wired if possible.

9. Cable or harness bend radius must not be less than eight times the cable diameter.

10. Avoid twisting or winding the cable along its axis during installation or removal.

11. Whenever mating connectors, always inspect each for damage or defects. For example, bent pins, pushed-back sockets, broken keys, etc.

12. Boots must be secured to cable or harness with cable tie to prevent boot from sliding off connector. Cable tie must be installed over cable or harness and butted up against boot where the cable or harness exits the boot.

13. Cables must not be installed in a manner which puts strain on the connector or results in more than twenty-four inches of excess length.

14. Be sure that metal clamps and cable ties do not cut through cable installation.

15. Check that all circular connectors are hand (finger) tight. Check that Sure-Seal connectors have clip/clamps in place. Check that Weather Pack, Metri Pack and Deutsch connectors are snapped together.

16. Check cable or harness tiedowns. Keep cable securely fastened to vessel frame.

17. Check the condition of the cable or harness at any “rub” point and wherever the cable or harness passes through a sheet metal hole and wherever clamps or metal cable ties are used.

18. Check cable or harness for cracks, effects of vibration, abrasion, brittleness or abuse.

19. Visually inspect for evidence of moisture or corrosion.

Wiring Connections

General

The vessel wiring for the Profile or E-Troll Module must be of sufficient size to prevent excessive voltage drop (no greater than 0.5 Vdc) between the battery connections (positive voltage and ground) and the Profile or E-Troll Module. The modules operate from nominal 12 VDC or 24 VDC batteries. The battery power connection must be protected by an electrical over-current protection component (fuse or circuit breaker) as required by the vessel's approval agency. The minimum current capacity should be 5 amps.

⚠ WARNING

DO NOT connect valve coils directly to battery power supply voltage. Use an approved Twin Disc Control System.

The customer supplied selector switches for each of the transmission clutches and for troll (if equipped) must be connected directly to the wires of the Profile or E-Troll Module, and connected to the power source as shown in the table that follows. No other electrical loads should be connected to this circuit.

Make the following Connections

The following power connection chart lists the possible configurations for connecting Electronic Profile or E-Troll Module to the power source for the three possible wiring options.

- ❑ Option 1 connections are used when the Profile or E-Troll Module is connected to non-electronic lever heads.
- ❑ Option 2 connections are used when the Profile or E-Troll Module is connected to electronic gear controllers.
- ❑ Option 3 connections are used when the Profile or E-Troll Module is connected to electronic control solenoid driver outputs. The electronic control's Solenoid A and B returns or negative signals should be connected together and connected to the E-Troll module return (if equipped). Electronic control solenoid drivers must have their solenoid return internally connected directly to ground. If not, the Profile or E-Troll Module must be interfaced to the electronic control with relays.

Table 20. Module Power Connection Chart

Wire	Wiring Option1	Wiring Option 2	Wiring Option 3
Troll Enable Switch Return (if equipped)	Connect to the Negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the same point as the control's power ground signal.
Solenoid B Switch	Connect to the Positive terminal of the engine battery through the switch contacts used to energize solenoid B.	Connect to the output in the gear controller that is used to energize Solenoid B.	Connect to the control's solenoid B Positive driver output.
Solenoid Return	Connect to the Negative terminal of the engine battery.	Connect to the same ground point used by the gear controller or the engine control.	Connect to the control's solenoid Negative output circuit.
Solenoid A	Connect to the Positive terminal of the engine battery through the switch contacts used to energize Solenoid A.	Connect to the output in the gear controller that is used to energize Solenoid A.	Connect to the control's Solenoid A positive driver output.

- ❑ The customer supplied normally closed not in neutral relay must be located in a position to not be affected by vibration. The coil must have a 200 maximum current draw. The coil must be connected to the two "not in neutral" wires of the Profile Generator.
- ❑ The contacts of the manual direction control switch (closed in neutral) must be wired in series with the energizing coil of the not in neutral relay.
- ❑ Plug the appropriate connectors from the Profile Generator into the appropriate Proportional Valves.
- ❑ Plug the appropriate connectors from the Profile Generator into the Engine Speed sensor and the Propeller speed sensor (if equipped).
- ❑ When the "not in neutral" circuit is not used, insulate and secure the blue and black wires.

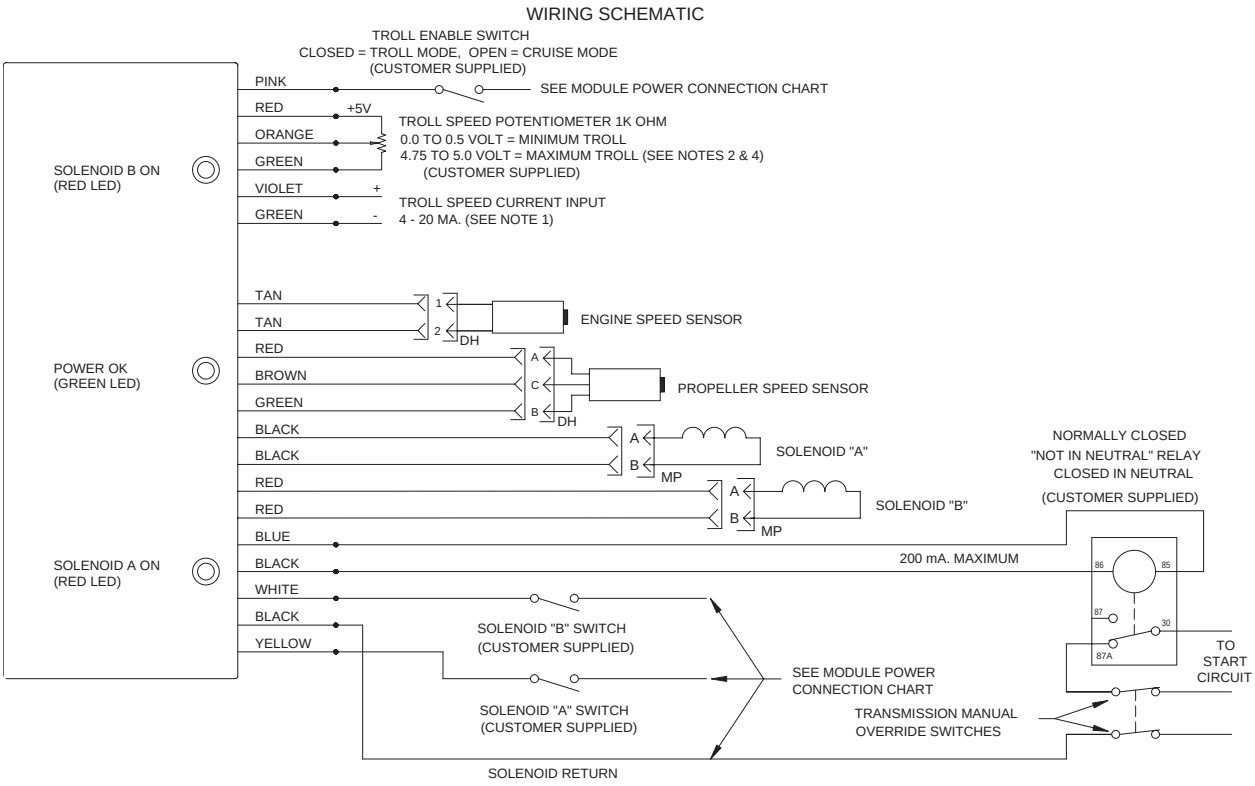


Figure 162. E-Troll Wiring Diagram

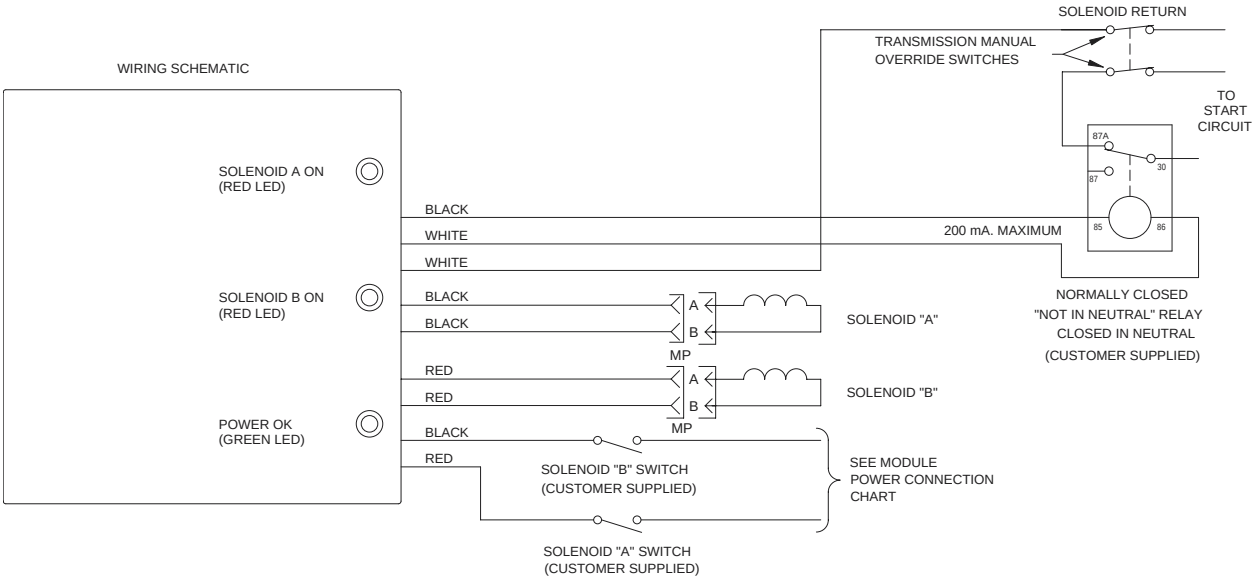


Figure 163. Profile Module Wiring Diagram

Final Checks

Be sure the transmission is filled with oil before starting. See Description and Specifications and Preventative Maintenance for proper oil and filling procedure.

Special Tools

List of Special Tools

The following pages include the special tool drawings that are specific to this model. The special tool drawings included are listed below and continued on the following page.

- ❑ THAP 300 Air-Driven Pump Set
- ❑ Release Spring Compressor
- ❑ Special Bearing Races
- ❑ Front Outer Bearing Race Installation Tool
- ❑ Inner Bearing Race Installation Tool
- ❑ Rear Outer Bearing Race Installation Tool
- ❑ Seal Installation Tool
- ❑ End-Play Bracket
- ❑ Output Gear Advance Tool
- ❑ 1020117 - “S” Valve Test Body
- ❑ B2408AL “S” Valve Test Procedure

Recommended Pump Set and Fluids

Twin Disc recommends the following products for use in the assembly and removal of tapered shafts using the oil injection method:

THAP 300 Air-Driven Pump Set

This set consists of the air-driven pump with accessories, such as an adapter block, pressure gauge, high pressure pipe, or pressure hose with quick connection couplings and connection nipples. The set includes one of each: air-driven pump [THAP 300], adapter block [226402], pressure gauge [1077589] and high pressure pipe (2m/6.5 ft.) [227957A].

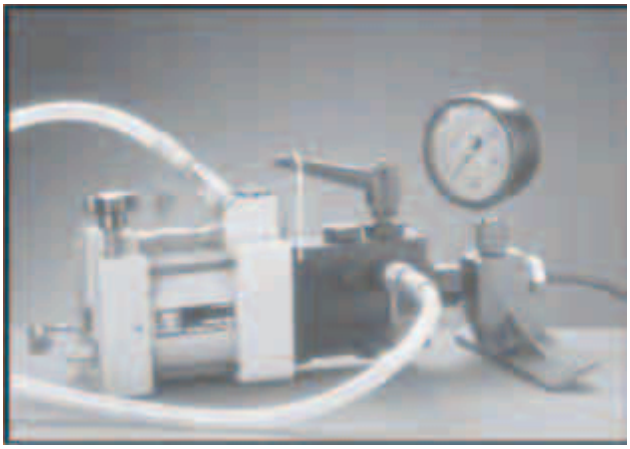


Figure 164. THAP 300 Air-driven Pump Set

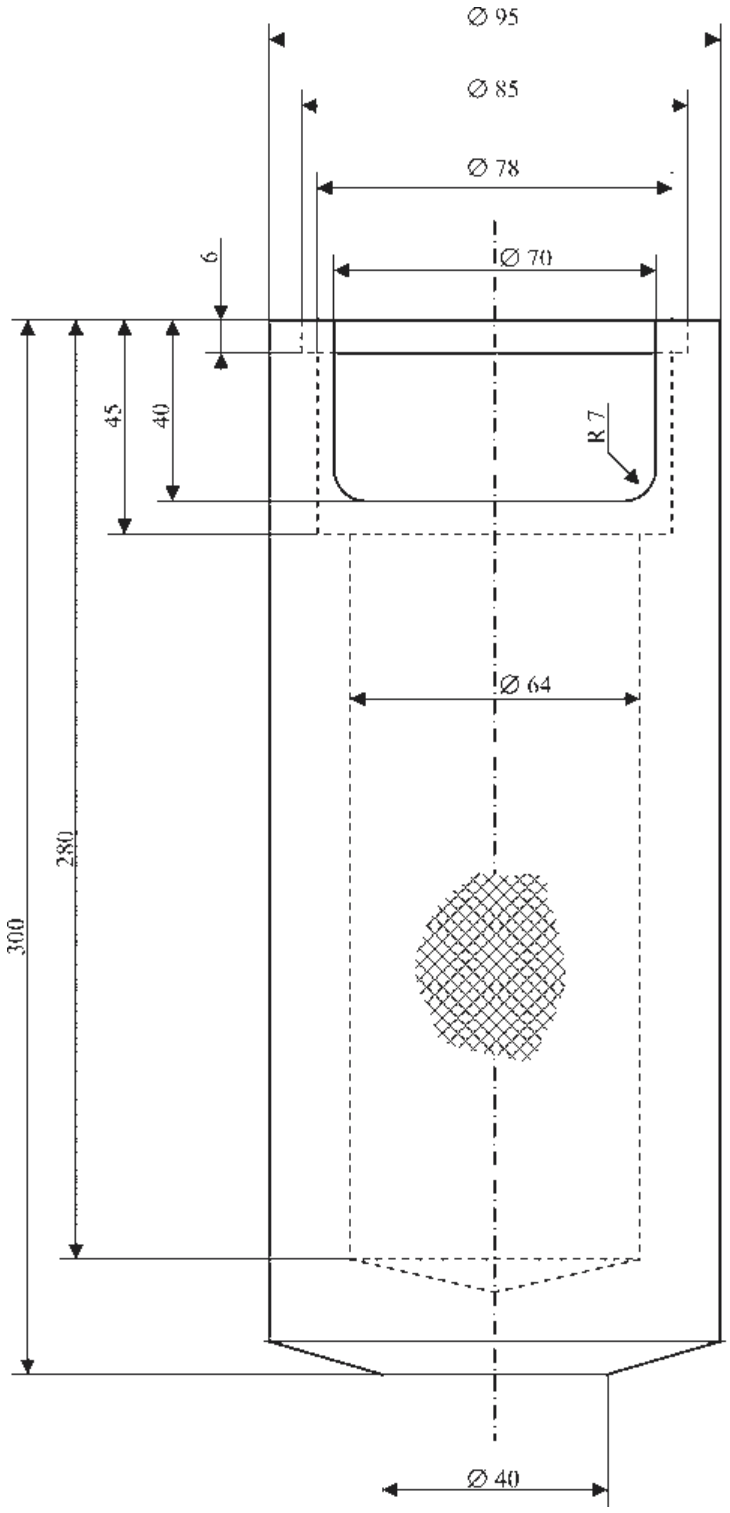
Mounting Fluid LHMF 300 and Dismounting Fluid LHDF 900

SKF LHMF 300 and LHDF 900 are recommended when using SKF hydraulic equipment like hydraulic pumps. HMV nuts, oil injection equipment, etc. The fluids contain anticorrosives and are non-aggressive to seal material like nitrile rubber, Buna N (Perbunan), chrome, leather, PTFE, etc. SKF LHMF 300 and LHDF 900 are available in 5 liter (5.3 qt.) cans. Designation: LHMF 300/5 and LHDF 900/6.

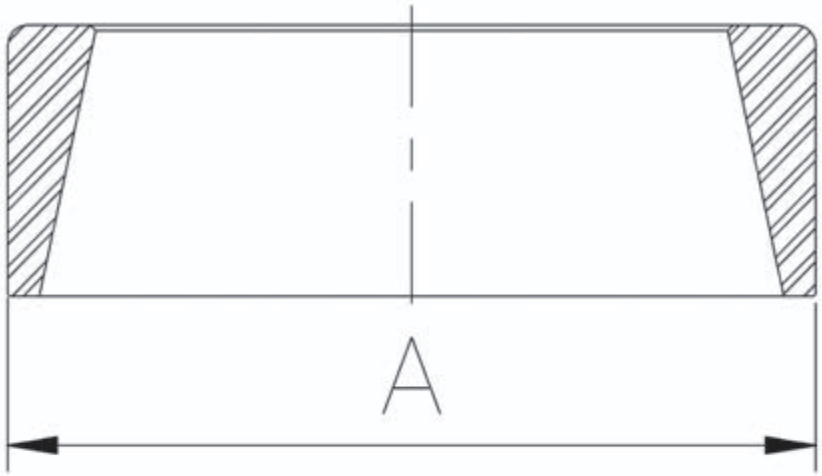
Figure 165. SKF LHMF 300 and LHDF 900

Note: Order Through Your Local Authorized SKF Distributor

Release Spring Compressor



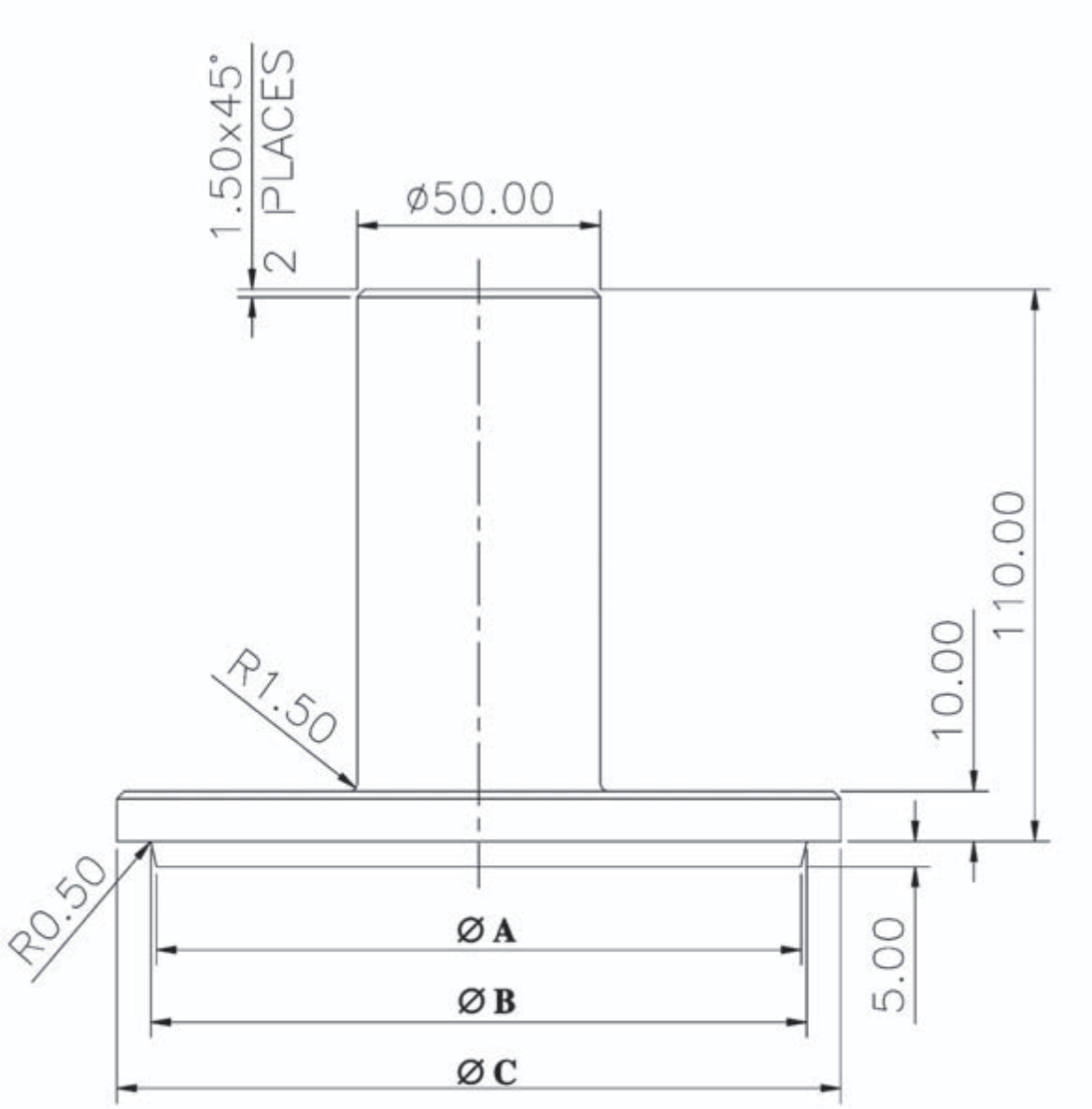
Special Bearing Races



Special bearing cups can be made by grinding 0.05 mm off the outside diameter (A) of standard outer bearing cups.

For **Primary** shaft preload adjustment
Grind outer diameter (A) of one bearing cup **PM 11445**
For **Secondary** shaft preload adjustment
Grind outer diameter (A) of one bearing cup **PM11446**
For **Ouput** shaft preload adjustment
Grind outer diameter (A) of one bearing cup **PM11448**

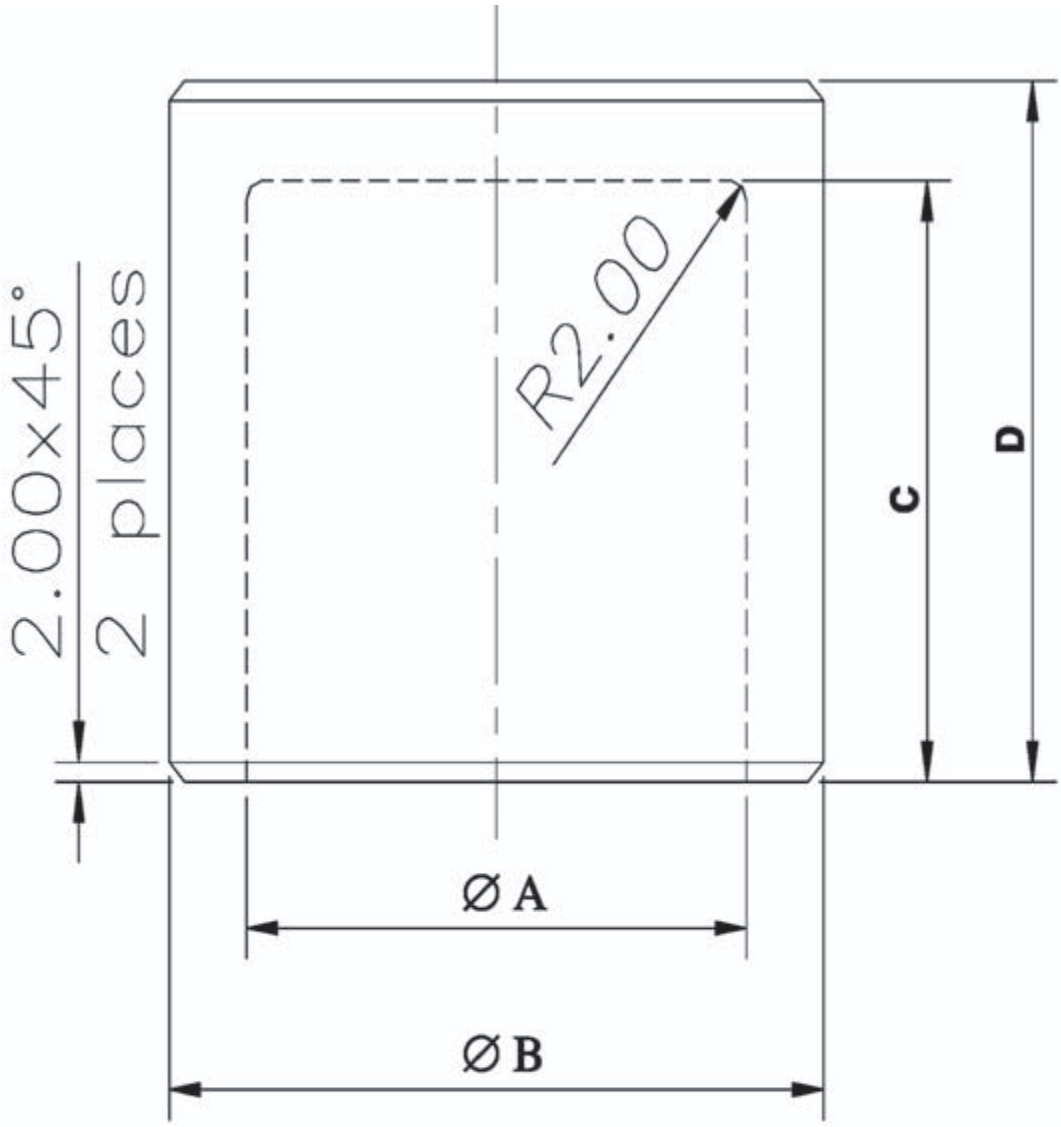
Front Outer Bearing Race Installation Tool



Outer Bearing Installation Tools for MG 5135A

A = 120	A = 144
B = 122	B = 149
C = 134	C = 159

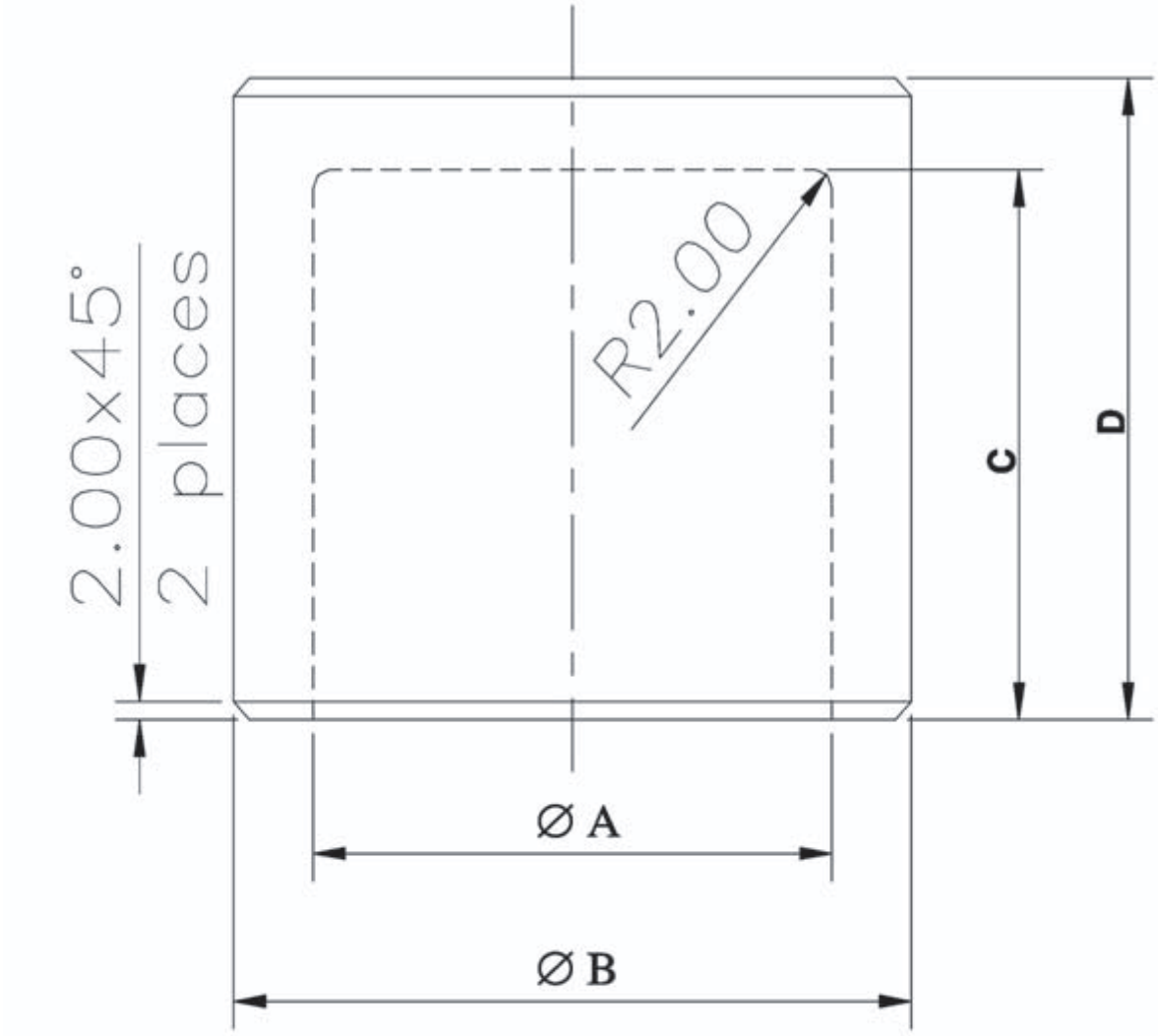
Inner Bearing Race Installation Tool



Inner Bearing Installation Tools for MG 5135A

A = 61	A = 64	A = 86
B = 75	B = 80	B = 95
C = 80	C = 100	C = 110
D = 100	D = 115	D = 125

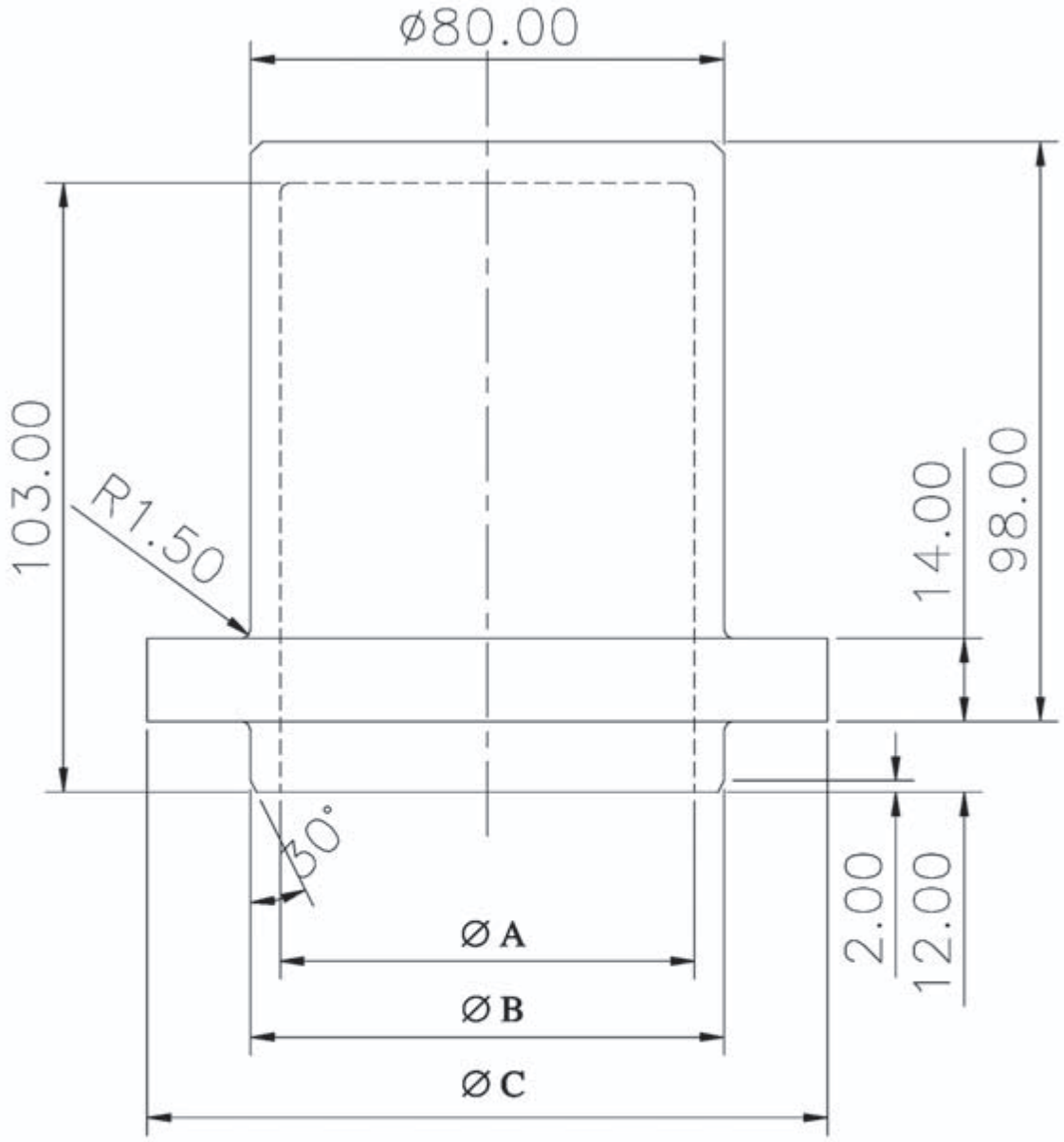
Rear Outer Bearing Installation Tool



Outer Bearing Installation Tools for MG 5135A

A = 100	A = 125
B = 129	B = 149
C = 70	C = 110
D = 80	D = 125

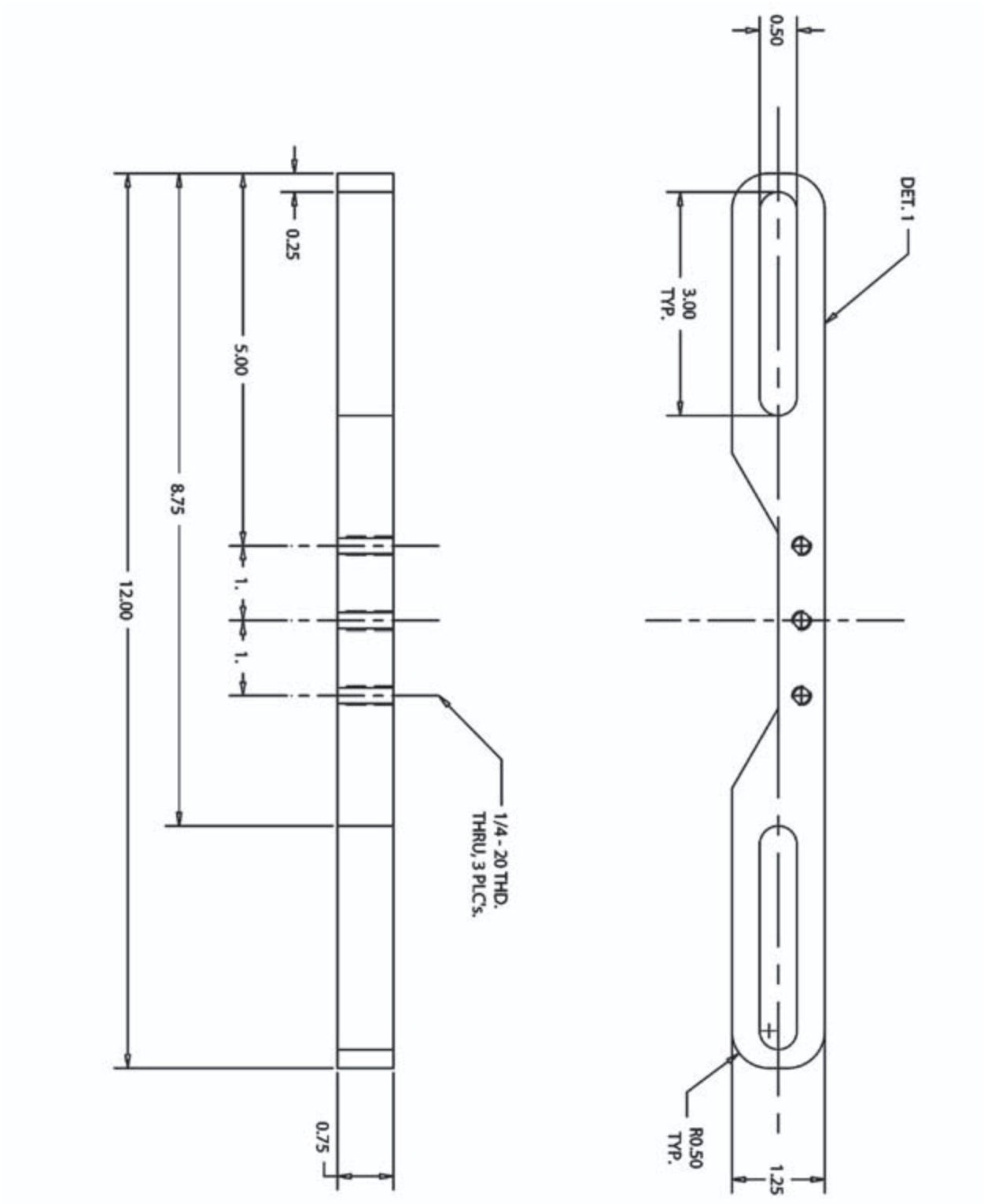
Seal Installation Tool



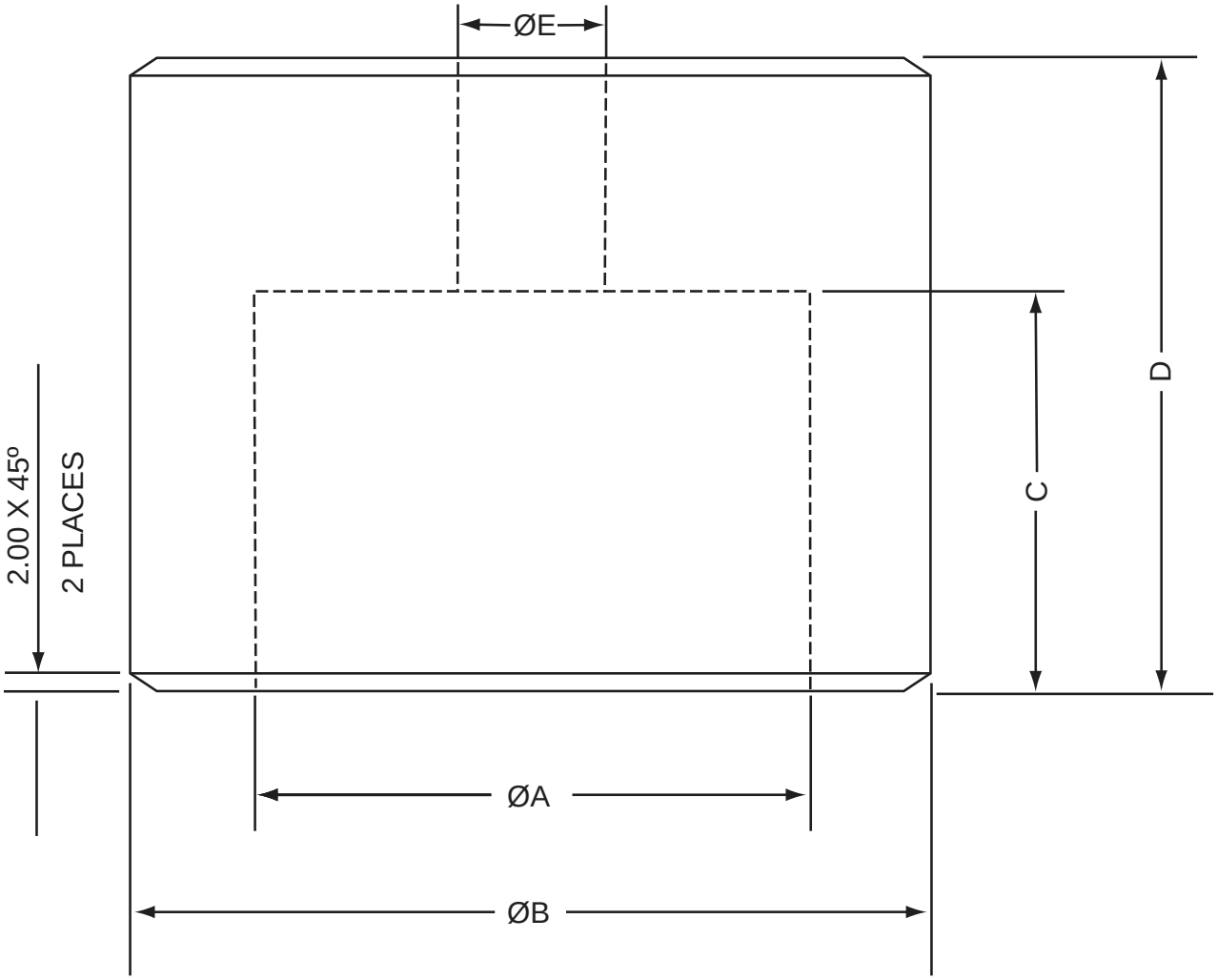
Seal Installation Tools for MG 5135 A

A = 70	A = 70
B = 82	B = 100
C = 108	C = 120

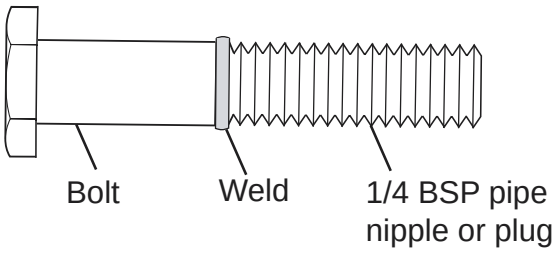
End-Play Bracket



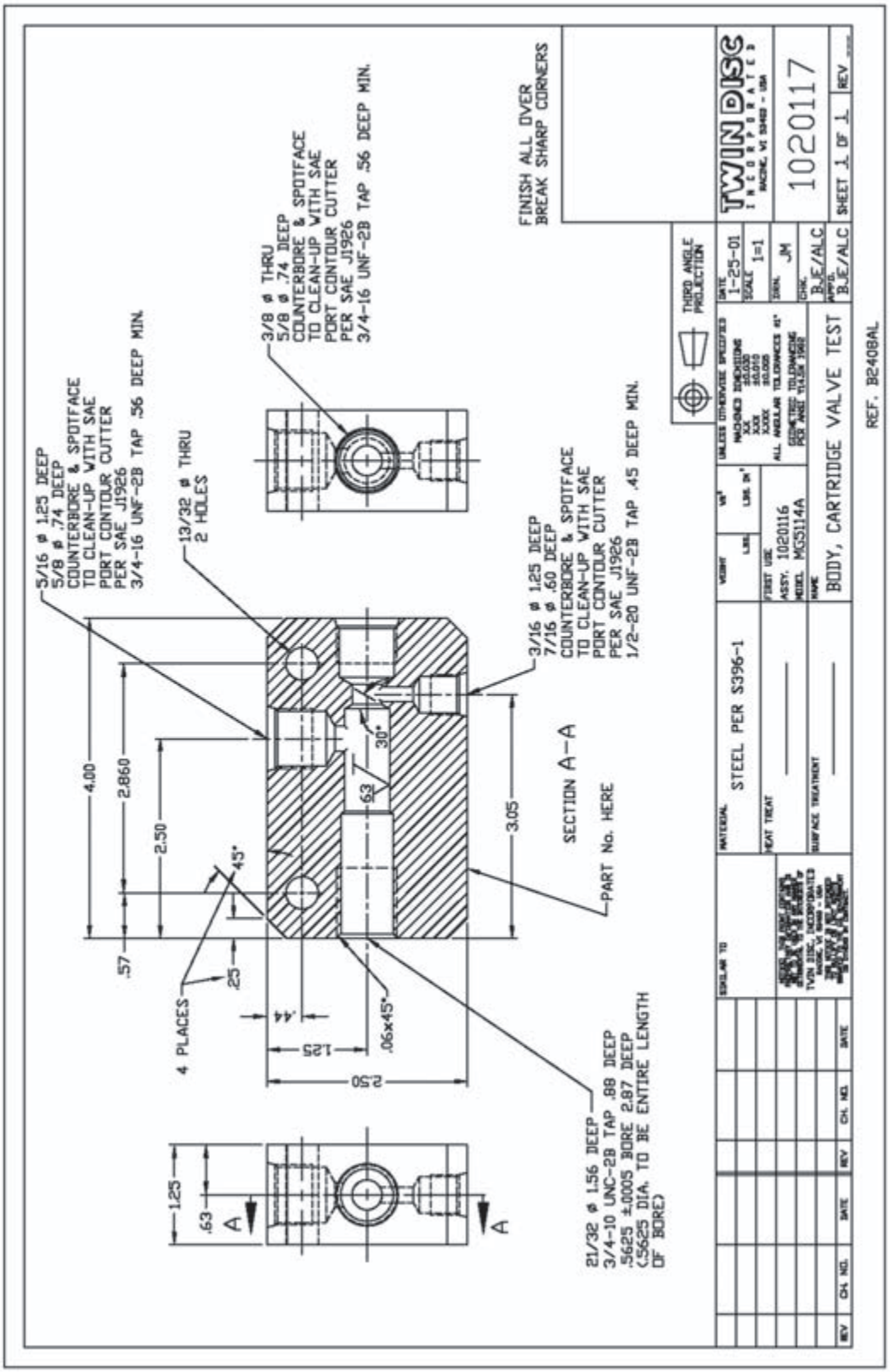
Output Gear Advance Tool



A = 80 mm
B = 115 mm
C = 55 mm
D = 85 mm
E = 16 mm



1020117 - “S” Valve Test Body



B2408AL "S" Valve Test Procedure

I. Testing of PX11801 and PX11801-A Cartridge Valve Assembly

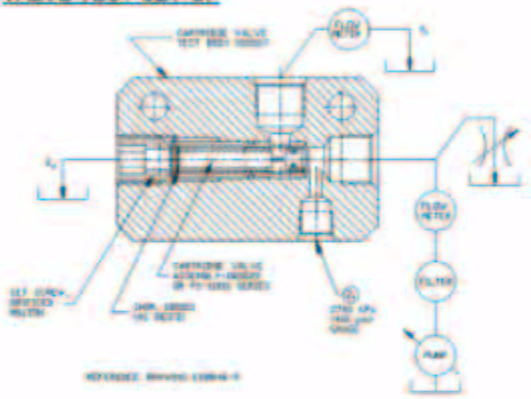
1. VALVE ASSEMBLY TEST

   A. For use when valve only is to be tested (at time of unit overhaul)
   B. This valve must always be tested as outlined below for all uses. The valve is to pass all of these checks and tests before being approved for shipment.
   C. Please follow applicable routing instructions carefully.
   D. Record all data.

2. MINIMUM EQUIPMENT SPECIFICATIONS

   A. Oil flow of 19 L/min (5 gpm) capacity with bypass of 2760 kPa (500 psi).
   B. Oil viscosity of 90 - 110 SUS (18.2 - 20.6 cS).
   C. Adapter plate 1020117 for proper mounting of cartridge valve to:
      1] Allow leakage oil at S_1 and S_2 to return to sump.
      2] Provide means to measure flow rates at S_1 and S_2.
      3] Provide 2760 kPa (400 psi) pressure gauge at Z_1.

3. VALVE TEST SET-UP



II. PX-11801 SERIES CARTRIDGE VALVE PRODUCTION TEST SHEET

1. Using a non-marring technique, mark the sequence valve with a serial number.
2. With the pressure at Z_1 set **1207 kPa (175 psi)**, Leakage at S_1 and S_2 to be no more than 1.0 L/min (.25 gpm). Record leakage flow rate at S_1 and S_2.
3. Slowly increase pressure at Z_1 until flow rate at S_1 is 2.3 L/min (.6 gpm). Add or remove the 1020111 shims as necessary to achieve the minimum sequence pressure of **1344 ± 34 kPa (195 ± 5 psi) for MGX5145, or 1448 ± 34 kPa (210 ± 5 psi) for MGX5147A**, and a flow rate of S_1 of 2.3 L/min (.6 gpm). Record final pressure at Z_1 with flow rate of 2.3 L/min (.6 gpm) at S_1.
4. Increase flow rate at S_1 to 3.8 L/min (1.0 gpm). Pressure at Z_1 to be within range charted in II.2. Record final pressure at Z_1 with flow rate of 3.8 L/min (1.0 gpm) at S_1.

III. PX-11801 SERIES CARTRIDGE VALVE PRODUCTION TEST SHEET

1. Sequence Valve Serial Number:_____
2. Leakage at S_1 with pressure at Z_1 set at charted pressure given in section II. 2.:_____
3. Leakage at S_2 with pressure at Z_1 set at charted pressure given in section II. 2.:_____
4. Pressure at Z_1 with flow rate of 2.3 L/min (.6 gpm) at S_1:_____
5. Pressure at Z_1 with flow rate of 3.8 L/min (1.0 gpm) at S_1:_____

Tester:_____ Date:_____

NOTES

Engineering Drawings

List of Engineering Drawings

The following pages include the engineering drawings that are specific to this model. The engineering drawings included are listed below and continued on the following page.

Note: Any part numbers listed in the following engineering drawings are for reference only. Please refer to your bill of material for part numbers specific to your model.

❑	PX-11840	MGX-5135SC Marine Transmission, Sectional View (sheet 1 of 6)
❑	PX-11840	MGX-5135SC Marine Transmission, General View (sheet 2 of 6)
❑	PX-11840	MGX-5135SC Marine Transmission, General View (sheet 3 of 6)
❑	PX-11840	MGX-5135SC Marine Transmission, General View (sheet 4 of 6)
❑	P-12182	Hydraulic Diagram
❑	PX-11615	
❑	PX-11615A	
❑	1020729	
❑	1021658	

PRIMARY & SECONDARY PINION (2 REQ'S)					GEAR OUTPUT (2 REQ'S)		
ASSEMBLY NUMBER	PINION *	HUB *	BUSHING *	NUMBER OF TEETH	PART NUMBER	NUMBER OF TEETH	RATIO
PX-11644	P-11638	P-11645	M-2073-DR	21	P-11637	61	2.90:1
PX-11643	P-11630	P-11642	M-2073-DR	23	P-11633	59	2.57:1
PX-11639	P-11639		M-2073-DR	27	P-11641	55	2.04:1
PX-11655	P-11655		M-2073-DR	30	P-11656	52	1.73:1
PX-11657	P-11657		M-2073-DR	33	P-11658	49	1.48:1
PX-11659	P-11659		M-2073-DR	36	P-11661	46	1.28:1
PRIMARY PINION (1 REQ'S)					GEAR OUTPUT (1 REQ'S)		
PX-12107	P-12107		M-2073-DR	39	P-12109	43	1.10:1
SECONDARY PINION (1 REQ'S)							
PX-12108	P-12108		M-2073-DR	39	Ⓛ		
PRIMARY PINION (1 REQ'S)					GEAR OUTPUT (1 REQ'S)		
PX-11662	P-11662		M-2073-DR	41	P-11663	41	1.00:1
SECONDARY PINION (1 REQ'S)							
PX-11664	P-11664		M-2073-DR	41			

GP VALVE:1021658A Ⓚ Ⓠ

FOR E-TROLL MODULE		FOR PROFILE MODULE	
1020584-A	1	1020586-A	1
1020282	11	1020282	5
MA1039-J	6	MA1039-J	6
MA1097-B	4	MA1097-B	4

PX-11801A	2	
P-11802 VALVE CARTRIDGE	1	*
1020099 PISTON	1	*
PM2057S WASHER	1	*
P-11849 SPRING	1	*
PM-3036AE1 PLUNGER	1	*
1020111 STEM	AS REQ'D.	*
A2916KH O-RING	1	
B1048U SNAP RING	1	

SEE CHART	
P-10951	1
M1990Q	1
PM-1190R	2
A2888G WASHER	2
A2706AC	1
MA929	1

P-11786-E	1
P-11771	1
PM-3254-F	2

SEE NOTE "a"

XB6239A R.H. ENGINE	1
XB6244A L.H. ENGINE	1
M1904AQ	4
1001218	1
M2020AD	4
1003790	1

1002496	2	
P-11683	1	
202178	1	
M2087E	4	
202178-A	4	
MA1041E	2	
P-11294	2	
P-11293	2	
M2693N	4	
P-10981	20	
P-12196	18	
P-11598	2	
A2916JW	2	
M1904EC	2	
P-11713-A	2	
PM-2009CU	2	
PM-4864AN	2	
PX-11829	1	
P-11828	1	
P-11745	1	
PM-5841-H	1	
PM-11445	1	

Ⓛ Ⓛ Ⓒ

FILTER BY-PASS

PM-11652	1	
B3646A	1	
M1731CP	1	
B1048H	1	
1003279	1	
1003436	1	
A2518A	1	
M2027F	2	
1003738	1	

TWIN DISC S.A. HIGH PRESSURE SPIN-ON

26.6

SET SPRING LENGTH TO 30.2mm(1.19 IN.)

FOR L.H. ENGINE ROTATION ONLY	
201513	1
M422	2

SEE NOTE "b"

INPUT SPEED SENSOR:

APPLY ANAEROBIC SEALANT MEETING"MA908 (LOCTITE 242)" TO SPEED SENSOR THREADS. ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, AND THE BACK OUT SENSOR "ONE" FULL TURN. USE JAM NUT TO SECURE SENSOR POSITION.

1020553	1	
M2027-AP	1	◑
M2081-J	1	

SECTION : "C-C" Ⓙ

PM-1190-B	1	
PM-1349-AC	1	Ⓚ

P10837 SAE#1	1	
1016217	1	

PX-11634	1	*	
P-11634	1	*	
MA-1064-A	12		
PM-1996-F	11		
PM-2057-Z	11		
P-11684	1		
P-11699	1		

SEE CHART		
PX-11828	1	
P-11828	1	*
P-11903	1	* Ⓒ
M-1990-D BALL STEEL	1	
PM-11446	1	

PM-2009-M	1
PM-1677-AK	1
P-11665	1
P-11358	1
PM-2009-AQ	1
P-11682	1

P-11680	1	
MA1038F	4	
P-10930-A	1	Ⓝ
PX-11452-A	2	
P-11452-A	1	Ⓜ
M1927L ROLL PIN	1	
A2916KB	1	
P-11786	1	
PM-4330-T	1	
1018234	1	
A2916BE	2	Ⓟ
P-11453	AS REQ'D.	
P-11453-A		
P-11453-B		
P-11453-C		
P-10931-A	1	Ⓝ
P-10936	1	
P-11681	1	
M-2074-EC	1	
P-11354	1	
PM-1996-P	3	
B-2423	AS REQ'D.	
B-2423-A		
B-2423-B		

SEE NOTE #6

P-12220	1
A2669DK	1
A2916CR	1

P11356	1
PM1399H	16
MA1041E	16
M2406	1
PM1996G	12
PM2057Z	12
1016215	1

SEE NOTE #3

OIL LEVEL MAX.

OIL LEVEL MIN.

P-11647 SAE#0	1	

OPTIONAL EXTRA-SUPPLIED ONLY WHEN SO SPECIFIED		
PX-11654	1	
P-12102	1	Ⓒ
MA1055A	8	
MA1048E	8	

P-11737-D	1	
PM-2306-C	4	Ⓑ

SUCTION SCREEN

A2916JT	1	
P-9926	1	
212754B	1	
B2130B	1	

P-11678	1		
PM-2009-CQ	1		
PM-1190-J	2		
PM-1190-U	2		
M-2081D	4		
PM-9805	1		
PX-11679	1	*	
P-11679	1	*	
MA-1054-A	4		
P-11628	1		
SEE CHART			

Ⓚ

PM-11448	1		
PM-2009-AT	AS REQ'D.		
P-11676			
P-11676-A			
P-11676-B			
PM-11444	1		Ⓑ
P-11671	1		
PM-1190-E	6		

Ⓜ

PM-10667-B	1	
M2051F	1	
PM-2057AJ	4	
PM-1357G	4	
M2702E	1	▲
MA1038A	2	
PM-2057Z	1	Ⓗ
PM1996M	1	
MA1038A	1	
M2988J	1	
M2702E	1	▲
PM-2057F	1	
PM-1357G	1	
PM-1357G	4	
PM-2057Z	13	Ⓗ
PM-1996K	4	
PM-5841-G	2	
PM-1996-R	5	
PM1534V	1	Ⓗ
PM1996-J	3	
MA-1040-B	1	

1021658-A	1		
MA-1052-U	4		Ⓓ Ⓚ Ⓠ Ⓑ
PM5967B	2		Ⓓ
PX11570	1		
MA-977	1		Ⓑ
B-2411-D	1		
B-3631-R	1		
MA-656-B	1		

CAUTION

XB2301J	1	
B2301	1	#
B2300	1	#
PM1349-AA	1	Ⓗ
M-2006-C	1	
M2051K	1	
202347	1	
PM1996F	4	
MA1038A	2	
P-11954	1	
M-422-B	8	
P-11791-B	1	
PM-1190-C	1	Ⓑ
PM-1190-F	1	
A-2888-AW	2	

OUTPUT SPEED SENSOR:

APPLY ANAEROBIC SEALANT MEETING"MA908 (LOCTITE 242)" TO SPEED SENSOR THREADS. ASSEMBLE SENSOR UNTIL CONTACTING TIP OF GEAR TOOTH, AND THE BACK OUT SENSOR "TWO" FULL TURN. USE JAM NUT TO SECURE SENSOR POSITION.

1020552	1	
PM2057-X	2	◑
M2027-AP	1	

SECTION : "D-D" Ⓙ

SHEET 1	CROSS SECTION WITH PARTS NUMBERS. (MAN. SELECTOR)
SHEET 2	INSTALLATION DRAWING.
SHEET 3	INSTALLATION DRAWING.
SHEET 4	MOUNTING PADS
SHEET 5	4 VIEWS
SHEET 6	FLEXIBLE COUPLING
P-12182	HYDRAULIC DIAGRAM Ⓓ Ⓚ
P-5244-Z	MASS ELASTIC SYSTEM.
B-3649-H	HEAT EXCHANGER REQUIREMENTS.

H	6939	22AUG03					
G	6875	21MAY03	Q	7346	27JAN05		
F	6865	30APR03	P	7292	270CT04		
E	6849	10APR03	N	7261	20SEP04		
D	6760	28NOV02	M	7245	09SEP04		
C	6728	24oct02	L	7154	23APR04		
B	6653	16AUG02	K	7054	190EC03		
A	6629	13MAY02	J	6986	07OCT03		
SYM	CH N°	DATE	SYM	CH N°	DATE		

* NOT SERVICEABLE SEPARATELY

▲ REMOVE BEFORE OPERATING, 2 PLACES, ALUMINUM PLUGS.

● OPTIONAL FOR S.A.E. #1

◓ OPTIONAL FOR S.A.E. #0

(J) ◑ OPTIONAL FOR SPEED SENSORS.

ASSEMBLY INSTRUCTIONS

(J) ASSEMBLE AND TEST PER S570BN NOTES 1 THRU 7 ARE IN S570BN

NOTE #6: CONTROL VALVE BOLTS ONLY ARE TO BE TORQUED DRY TO 53.0-61.0 N m (39-45 LB.-FT.) OR WELL OILED TO 43.0-49.0 N m (32-36 LB.-FT.)

Ⓓ

THESE STANDARDS APPLY:

S574- FASTENER TORQUE REQUIREMENTS.
S692- THRUST BEARING SHIMMING.
S765- TAPERED JOINT ASSEMBLY.
S774- ANAEROBIC SEALANT APPLICATION.

CUSTOMER NOTES:

a) OIL CAPACITY 15.1 L (4.00 GALS.), LESS HOSES AND HEAT EXCHANGER.
b) ROTATION ARROW AND PUMP POSITION FOR R.H. ENGINE IS SHOWN.FOR L.H. ENGINES,ROTATION PLATE(ARROW POINTING TO RIGHT) AND SCREWS MUST BE ADDED TO INDICATE OPPOSITE DIRECTION AND PUMP TO BE RELOCATED PER INSTRUCTIONS SHOWN ON SHEET 2.
c) OPTIONAL EQUIPMENT:
COMPANION FLANGE ASS'Y. :PX-11654
LIVE P.T.O. PX-11824
HYDR. CLUTCHED P.T.O.SHAFT DRIVE :PX-11615-D
HYDR. CLUTCHED PUMP DRIVE :PX-11615-E

OIL TEMPERATURE INDICATING SWITCH :B3424, FOR INSTALLATION LOCATION, SEE HYDRAULIC DIAGRAM AND SHEET 2.

OIL PRESSURE GAGE :B1703D FOR INSTALLATION LOCATION, SEE HYDRAULIC DIAGRAM AND SHEET 2.

MAX. INPUT SPEED: 2500 R.P.M. CONSULT SALES DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

METRIC

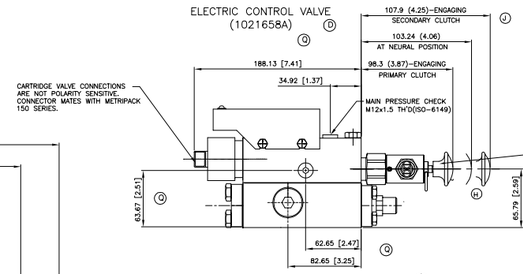
THIRD ANGLE PROJECTION

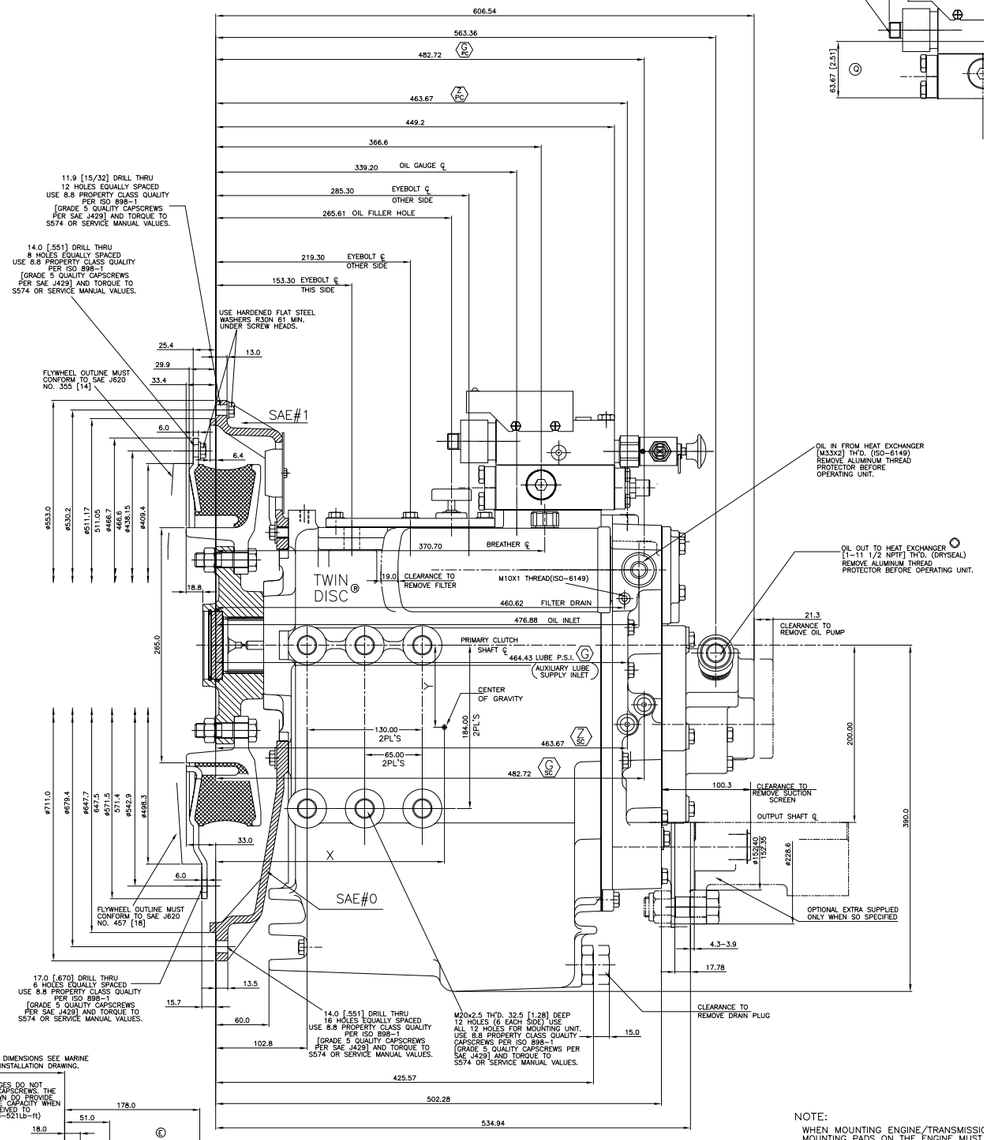
SIMILAR TO :	MATERIAL	WEIGHT kg	mN Nm	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN mm MACHINED SURFACES ±0.25 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DATE 10APR02 SCALE 1/2 DRAWN SP CHECKED VR APPROVED JCP
MODEL THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS SOLELY FOR THE BENEFIT OF TWIN DISC, INCORPORATED RACINE, WI 53403 - USA THIS NOTICE IS NOT INTENDED TO LIMIT OR LIMIT OWNERSHIP OF OTHERS BY CONTRACT.	HEAT TREAT	FIRST USE : ASSEMBLY N°: MODEL N° :			
	SURFACE TREATEMENT	NAME MGX-5135-SC MARINE ASS'Y			SHEET 1 REVISION : Q FORMAT A0

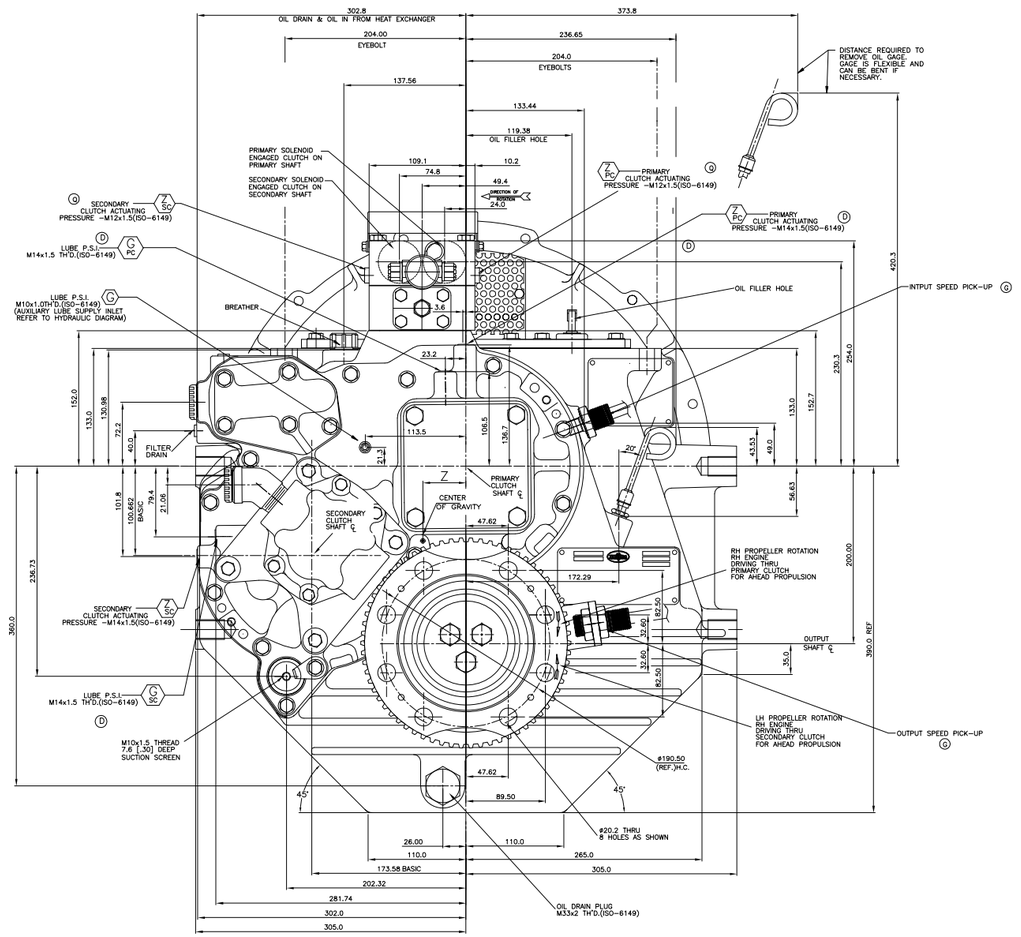
TWIN DISC INCORPORATED RACINE, WI 53403 - USA

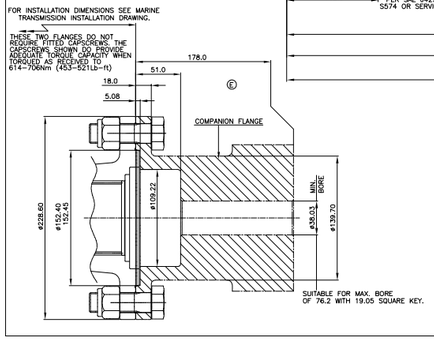
PX-11840

HEAT EXCHANGER (H.E.) REQUIREMENTS
REFER TO B3649H FOR HEAT EXCHANGER DATA.





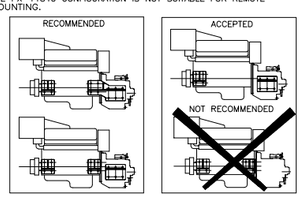




CENTER OF GRAVITY		
X	Y	Z

NOTE:
WHEN MOUNTING ENGINE/TRANSMISSION IN BOAT, ALL THE MOUNTING PADS ON THE ENGINE MUST BE USED – PLUS THE TRANSMISSION SIDE MOUNTING PADS. FAILURE TO DO SO MAY RESULT IN DAMAGE TO TRANSMISSION. SEE BELOW:

THE PX–11840 CONFIGURATION IS NOT SUITABLE FOR REMOTE MOUNTING.



NOTE:
ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡.

MAX. INPUT SPEED: 2500 R.P.M.
CONSULT SALES DEPT. APPLICATION
ENGINEERS FOR OTHER
LIMITING CONDITIONS.

METRIC
THIRD ANGLE PROJECTION

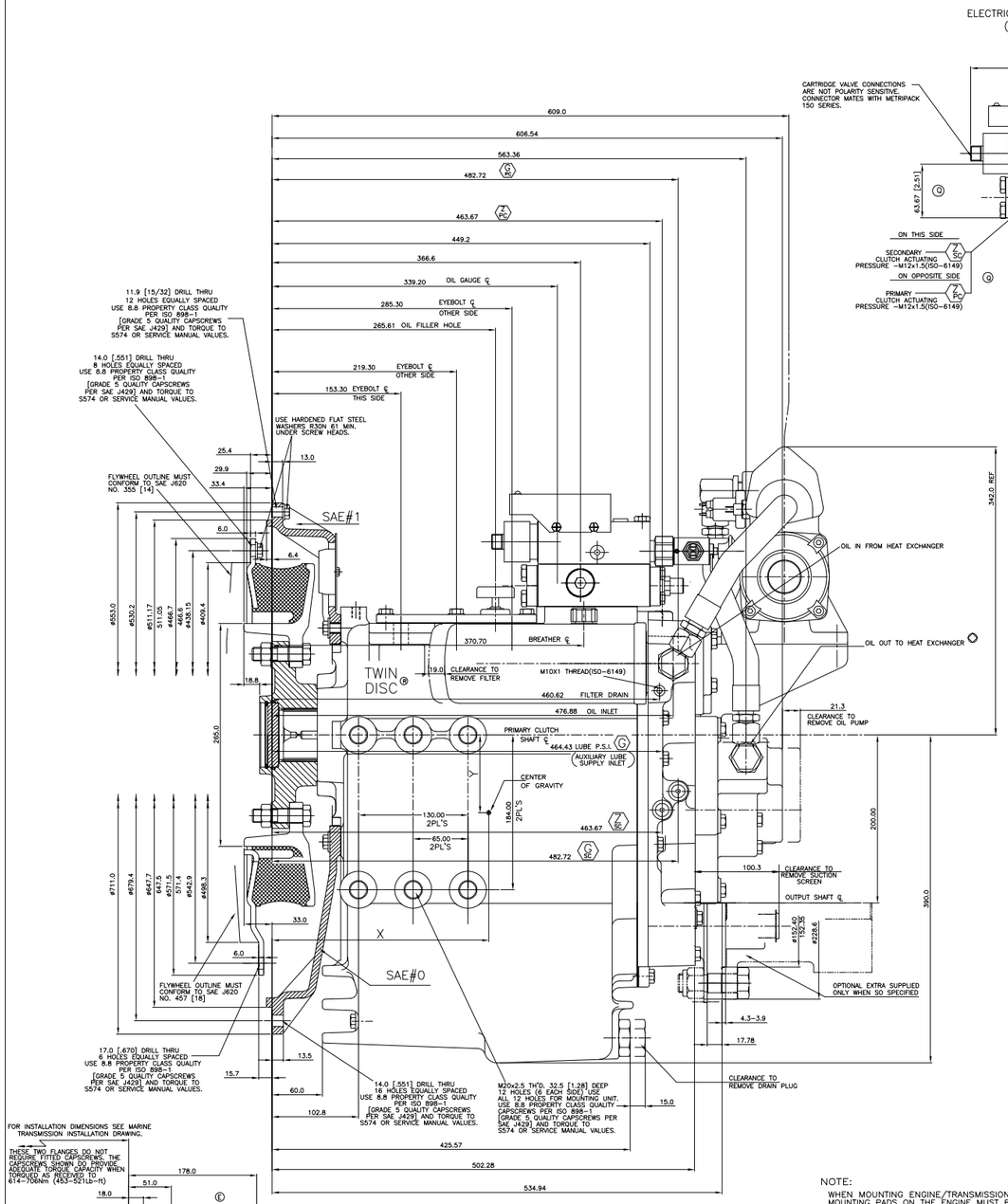
SIMILAR TO :	GEAR RATIOS: 1.00 :1, 1.28 :1, 1.48 :1, 1.73 :1; 2.04 :1; 2.57 :1; 2.90:1	WEIGHT kg	WR² Nm²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X ±0.75, X.X ±0.25, X.XX ±0.13, ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DATE 15MAY02
NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 – USA. THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERMENT OR OTHERS BY CONTRACT.	HEAT TREAT	FIRST USE :			SCALE 1/3
		ASSEMBLY N° :			DRAWN SP
		MODEL N° :			CHECKED VR
	SURFACE TREATEMENT	NAME MGX–5135–SC ASSEMBLY DRAWING			APPROVED JCP

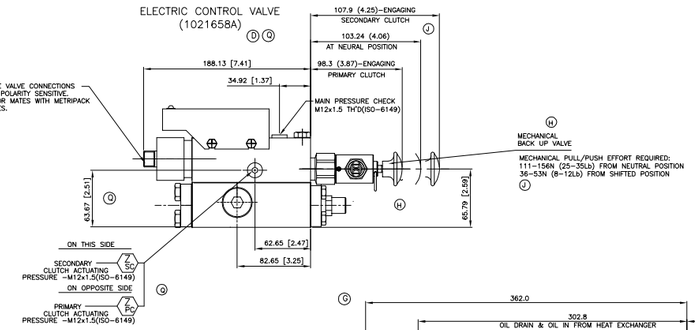
TWIN DISC INCORPORATED
RACINE, WI 53403 – USA

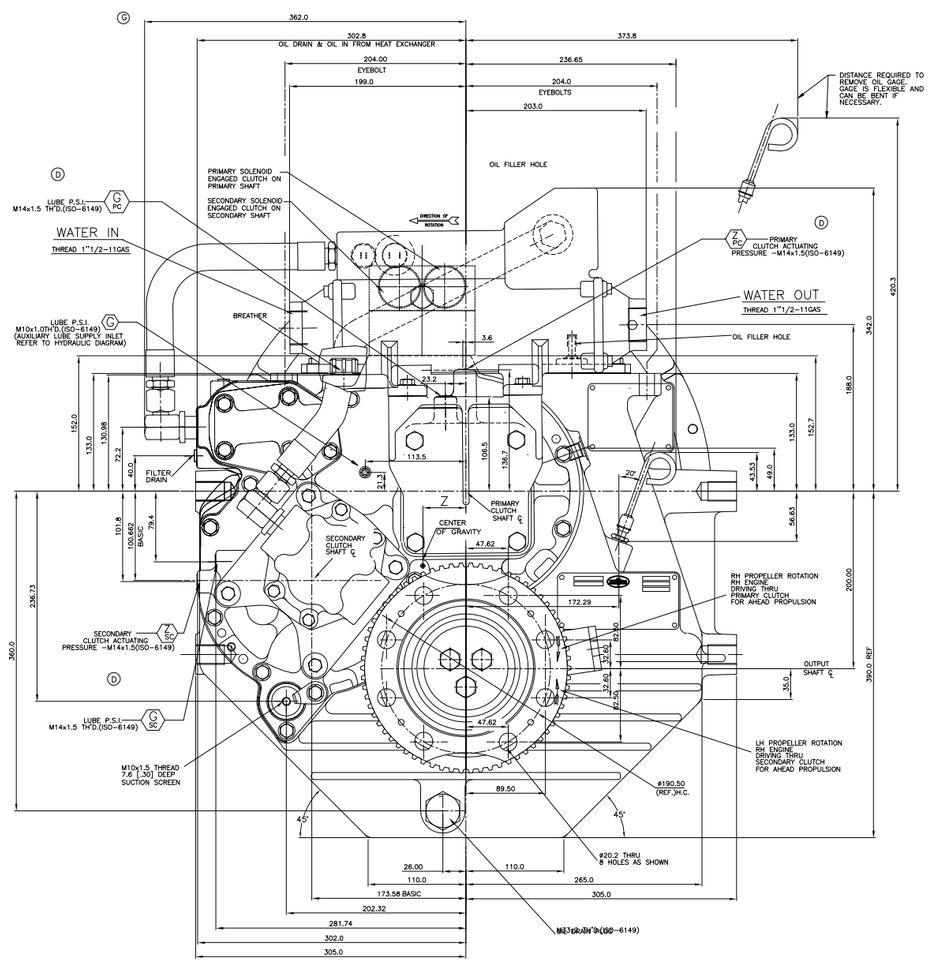
PX–11840

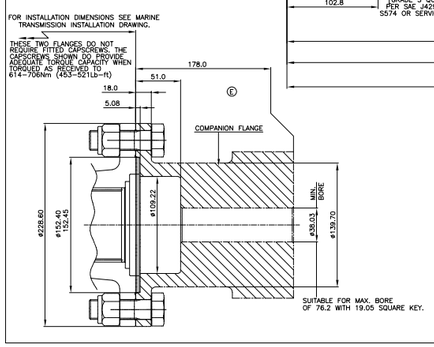
SHEET 2 | REVISION : Q | FORMAT A1

HEAT EXCHANGER (H.E.) REQUIREMENTS
REFER TO B3649H FOR HEAT EXCHANGER DATA.


609.0
606.54
563.36
482.72
463.67
449.2
366.6
339.20 OIL GAUGE ℄
285.30 EYEBOLT ℄ OTHER SIDE
265.61 OIL FILLER HOLE
219.30 EYEBOLT ℄ OTHER SIDE
153.30 EYEBOLT ℄ THIS SIDE
11.9 [15/32] DRILL THRU 12 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY PER ISO 898-1 [GRADE 5 QUALITY CAPSCREWS PER SAE J429] AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
14.0 [.551] DRILL THRU 8 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY PER ISO 898-1 [GRADE 5 QUALITY CAPSCREWS PER SAE J429] AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
USE HARDENED FLAT STEEL WASHERS R30N 61 MIN. UNDER SCREW HEADS.
FLYWHEEL OUTLINE MUST CONFORM TO SAE J620 NO. 355 [14]
SAE#1
OIL IN FROM HEAT EXCHANGER
OIL OUT TO HEAT EXCHANGER
342.0 REF
370.70 BREATHER ℄
19.0 CLEARANCE TO REMOVE FILTER
M10X1 THREAD(ISO-6149)
460.62 FILTER DRAIN
476.88 OIL INLET
21.3 CLEARANCE TO REMOVE OIL PUMP
PRIMARY CLUTCH SHAFT ℄
464.43 LUBE P.S.I. (G) AUXILIARY LUBE SUPPLY INLET
CENTER OF GRAVITY
130.00 2PL'S
65.00 2PL'S
184.00 2PL'S
463.67 (Z PC)
482.72 (G PC)
265.0
711.0 ø679.4 ø647.7 647.5 ø511.5 511.44 ø542.9 ø498.3
33.0
6.0
X
SAE#0
FLYWHEEL OUTLINE MUST CONFORM TO SAE J620 NO. 457 [18]
100.3 CLEARANCE TO REMOVE SUCTION SCREEN
OUTPUT SHAFT ℄
ø152.40 ø152.35 ø228.6
200.00
390.0
OPTIONAL EXTRA SUPPLIED ONLY WHEN SO SPECIFIED
4.3-3.9
17.78
CLEARANCE TO REMOVE DRAIN PLUG
17.0 [.670] DRILL THRU 6 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY PER ISO 898-1 [GRADE 5 QUALITY CAPSCREWS PER SAE J429] AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
14.0 [.551] DRILL THRU 16 HOLES EQUALLY SPACED USE 8.8 PROPERTY CLASS QUALITY PER ISO 898-1 [GRADE 5 QUALITY CAPSCREWS PER SAE J429] AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
M20x2.5 THD. 32.5 [1.28] DEEP 12 HOLES (6 EACH SIDE) USE ALL 12 HOLES FOR MOUNTING UNIT. USE 8.8 PROPERTY CLASS QUALITY CAPSCREWS PER ISO 898-1 GRADE 5 QUALITY CAPSCREWS PER SAE J429) AND TORQUE TO S574 OR SERVICE MANUAL VALUES.
15.7
60.0
102.8
425.57
502.28
534.94
15.0


ELECTRIC CONTROL VALVE (1021658A)
107.9 (4.25)-ENGAGING SECONDARY CLUTCH
103.24 (4.06) AT NEURAL POSITION
98.3 (3.87)-ENGAGING PRIMARY CLUTCH
188.13 [7.41]
34.92 [1.37]
CARTRIDGE VALVE CONNECTIONS ARE NOT POLARITY SENSITIVE. CONNECTOR MATES WITH METRIPACK 150 SERIES.
MAIN PRESSURE CHECK M12x1.5 TH'D(ISO-6149)
MECHANICAL BACK UP VALVE
MECHANICAL PULL/PUSH EFFORT REQUIRED: 111-156N (25-35Lb) FROM NEUTRAL POSITION 36-53N (8-12Lb) FROM SHIFTED POSITION
63.67 [2.51]
65.79 [2.59]
62.65 [2.47]
82.65 [3.25]
ON THIS SIDE
SECONDARY CLUTCH ACTUATING PRESSURE -M12x1.5(ISO-6149)
ON OPPOSITE SIDE
PRIMARY CLUTCH ACTUATING PRESSURE -M12x1.5(ISO-6149)

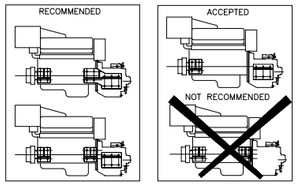




CENTER OF GRAVITY		
X	Y	Z

NOTE:
WHEN MOUNTING ENGINE/TRANSMISSION IN BOAT, ALL THE MOUNTING PADS ON THE ENGINE MUST BE USED -- PLUS THE TRANSMISSION SIDE MOUNTING PADS. FAILURE TO DO SO MAY RESULT IN DAMAGE TO TRANSMISSION. SEE BELOW:

THE PX-11840 CONFIGURATION IS NOT SUITABLE FOR REMOTE MOUNTING.



NOTE:
ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡.

MAX. INPUT SPEED: 2500 R.P.M.
CONSULT SALES DEPT. APPLICATION ENGINEERS FOR OTHER LIMITING CONDITIONS.

METRIC
THIRD ANGLE PROJECTION

SIMILAR TO :	GEAR RATIOS: 1.00 :1, 1.28 :1, 1.48 :1, 1.73 :1, 2.04 :1, 2.57 :1, 2.90:1	WEIGHT kg	WR² Nm²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982	DATE 15MAY02
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	SURFACE TREATEMENT	NAME MGX-5135-SC ASSEMBLY DRAWING			DRAWN SP
					CHECKED VR
					APPROVED JCP

TWIN DISC INCORPORATED RACINE, WI 53403 – USA

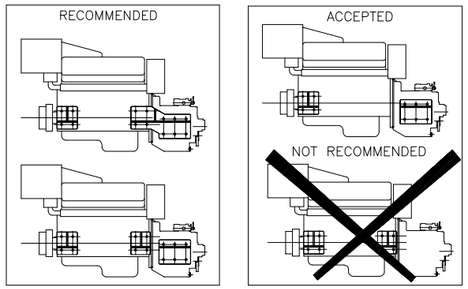
PX-11840

SHEET 3 | REVISION : Q | FORMAT A1

NOTE:

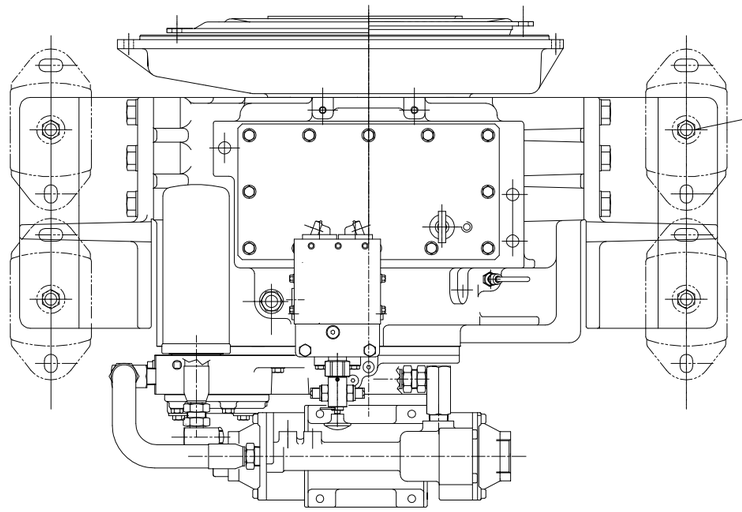
WHEN MOUNTING ENGINE/TRANSMISSION IN BOAT, ALL THE MOUNTING PADS ON THE ENGINE MUST BE USED – PLUS THE TRANSMISSION SIDE MOUNTING PADS. FAILURE TO DO SO MAY RESULT IN DAMAGE TO TRANSMISSION. SEE BELOW:

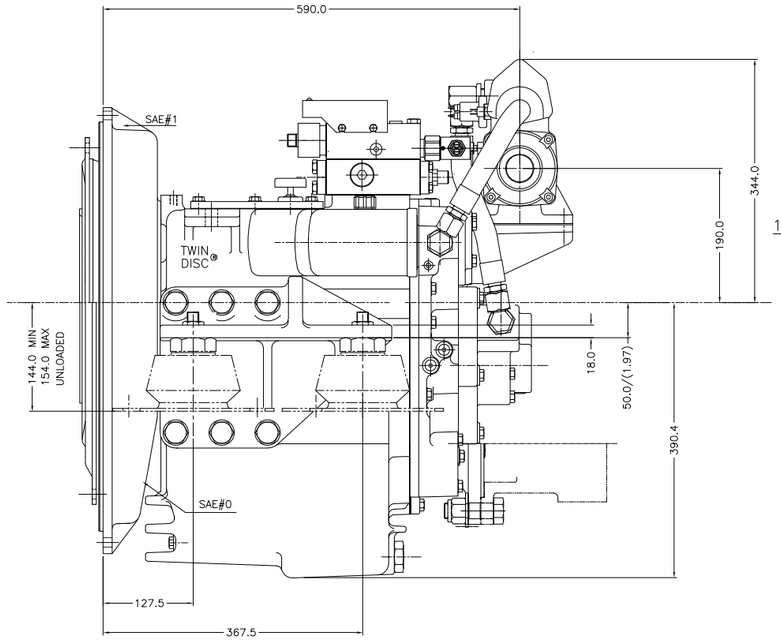
THE PX–11840 CONFIGURATION IS NOT SUITABLE FOR REMOTE MOUNTING.

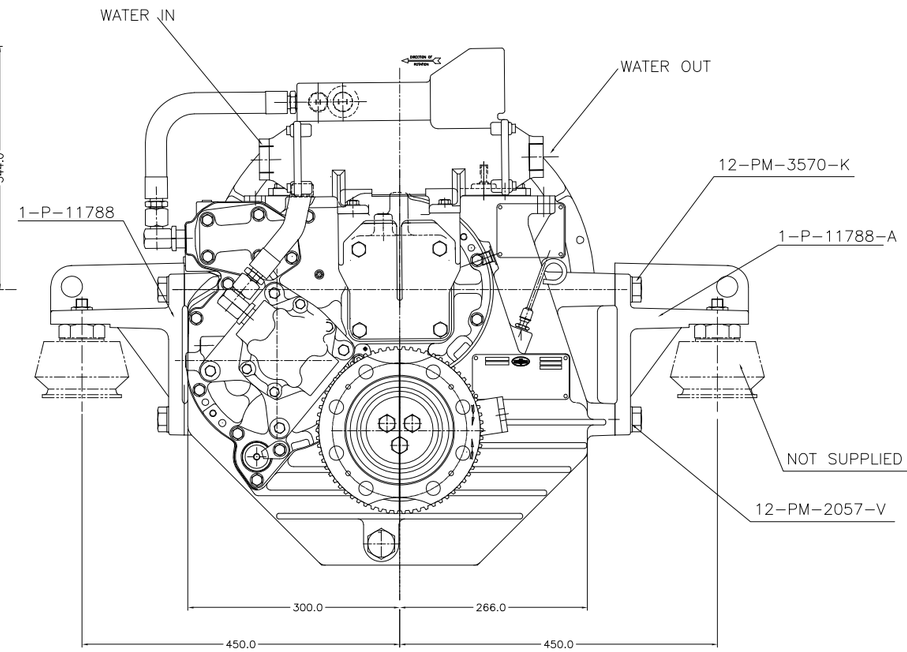


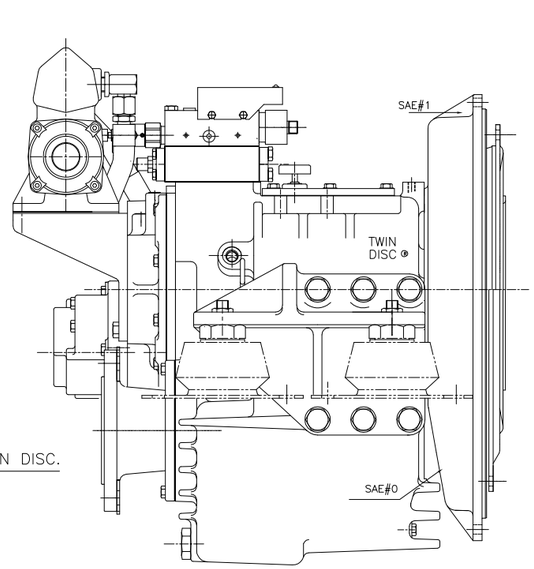
HEAT EXCHANGER (H.E.) REQUIREMENTS

REFER TO B3649 FOR HEAT EXCHANGER REQUIREMENTS









FOR OTHERS INSTALLATION DIMENSIONS
SEE DRAWING PX–11840 SHEET 2.

SCALE 0 20 40 60 mm / 0 1.0 2.0 3.0 INCH

METRIC

THIRD ANGLE PROJECTION

SIMILAR TO

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MATERIAL	WEIGHT LBS.	WR² LBS. IN²	DATE 15MAY02
HEAT TREAT	FIRST USE		SCALE 1/4
	ASSY.		DRN. SP
	MODEL		CHK. VR
SURFACE TREATMENT	NAME MGX5135–SC MARINE TRANSMISSION		APPD. PJC

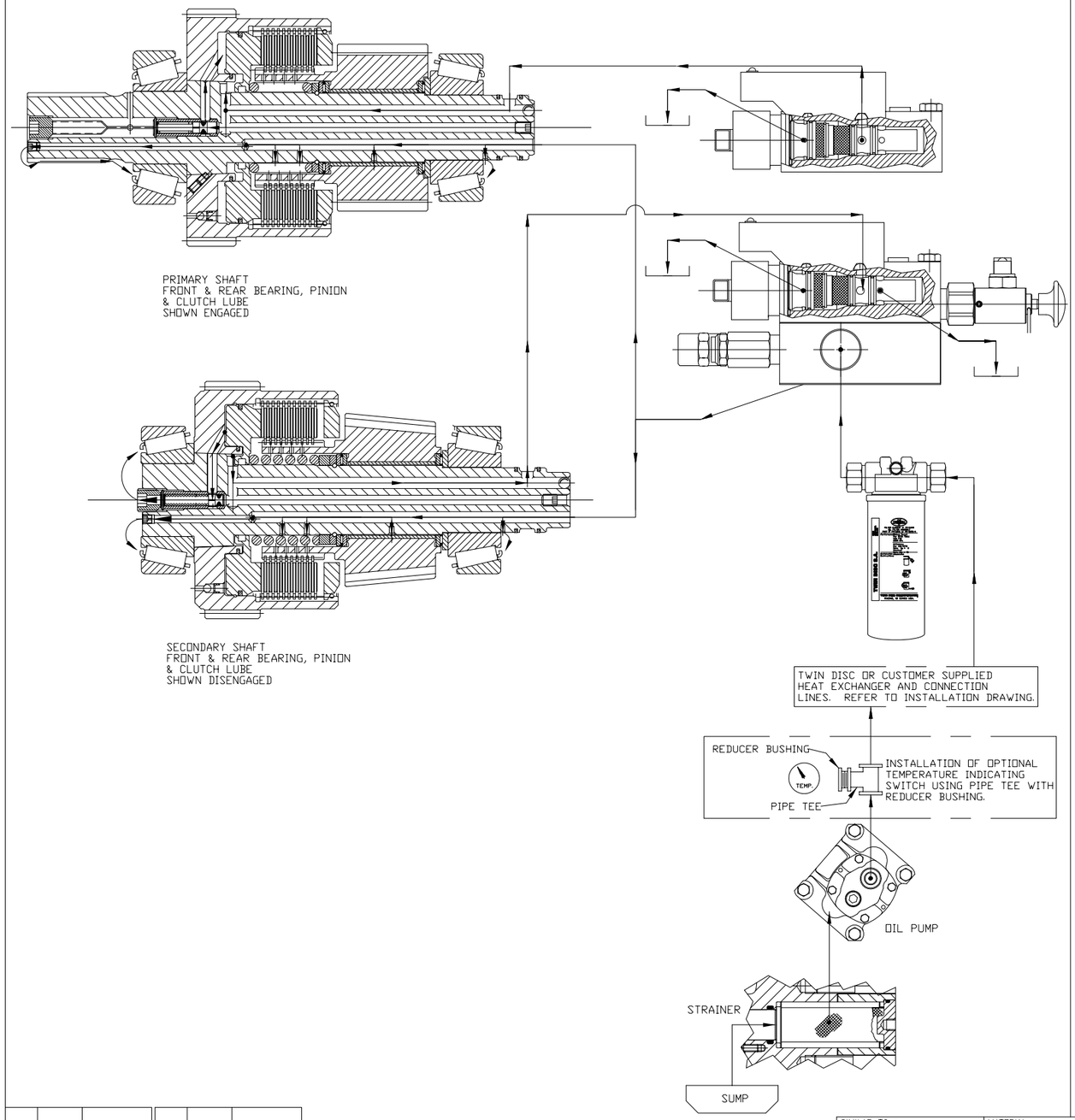
TWIN DISC INCORPORATED RACINE, WI 53403 – USA

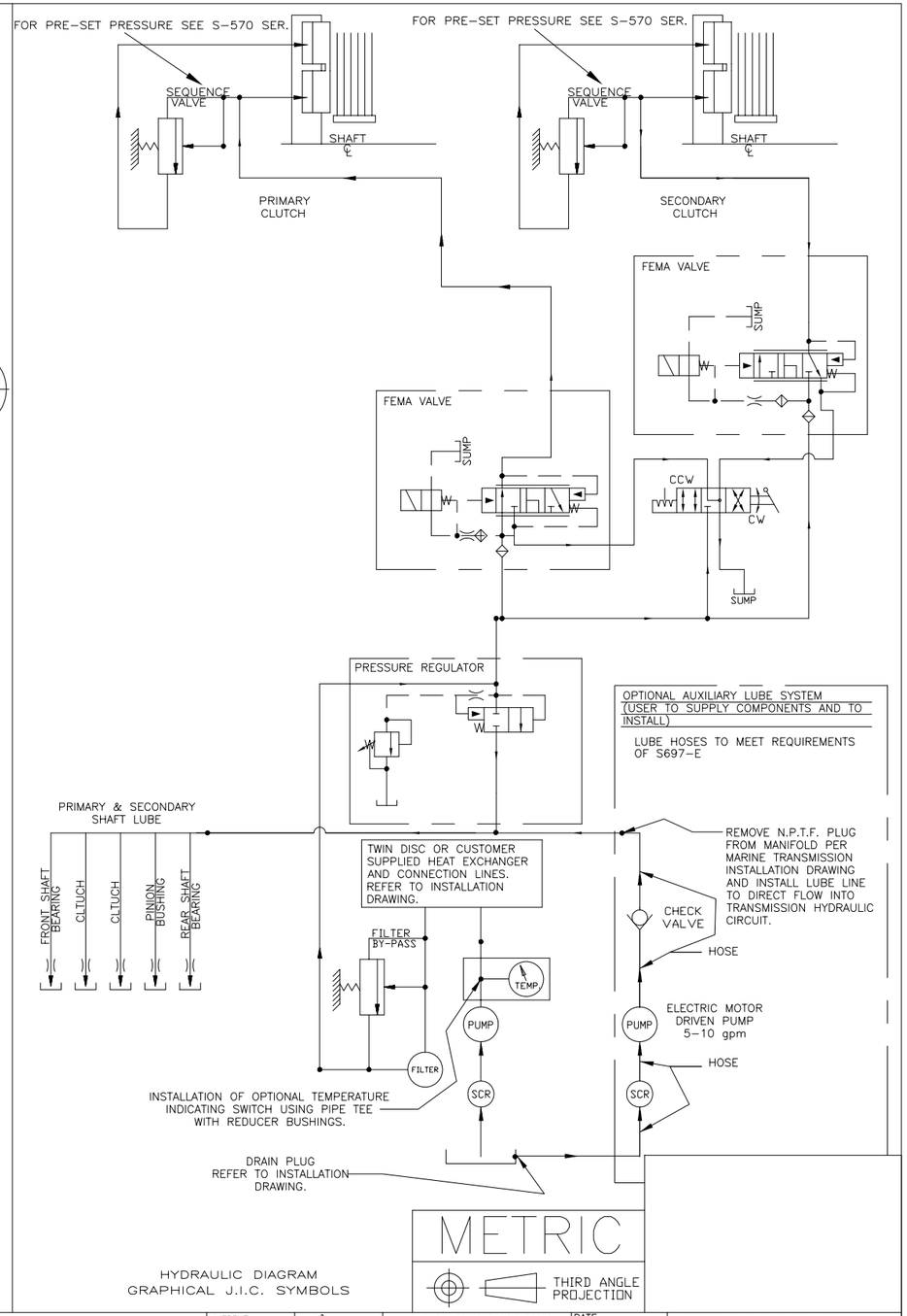
PX–11840

SHEET 4 REV : Q

F E D C B A

6 5 4 3 2 1





HYDRAULIC DIAGRAM
GRAPHICAL J.I.C. SYMBOLS

SYM	CH N°	DATE	SYM	CH N°	DATE

MGX S-CLUTCH
HYDRAULIC DIAGRAM
PICTORIAL

SIMILAR TO :	MATERIAL	WEIGHT kg	WR² Nm²	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm MACHINED DIMENSIONS X. ±0.75 X.X ±0.25 X.XX ±0.13 ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
NOTICE! THIS PRINT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE USED IN ANY MANNER DETRIMENTAL TO THE INTERESTS OF TWIN DISC, INCORPORATED RACINE, WI 53403 - USA THIS NOTICE IS NOT INTENDED TO NULLIFY OR LIMIT RIGHTS GRANTED TO THE U.S. GOVERMENT OR OTHERS BY CONTRACT.	HEAT TREAT	FIRST USE : ASSEMBLY N°: MODEL N° : MGX-SERIES		
	SURFACE TREATEMENT	NAME MGX HYDRAULIC DIAGRAM		

DATE	11DEC03
SCALE	NONE
DRAWN	SP
CHECKED	VR
APPROVED	JCP

TWIN DISC INCORPORATED
RACINE, WI 53403 - USA

P-12182

SHEET 1/1 | REVISION : | FORMAT A2

P.T.O ASSEMBLY TO MARINE TRANSMISSION–(FACTORY AND FIELD INSTALLATION) :

1.FOR FACTORY INSTALLATION: THE PARTS (⧫) A2916BE RING"O"(1);PM1996F SCREWS(4); 202347 COVER(1);MA1038A (2)ON MANIFOLD; MUST BE OMITTED.

FOR FIELD INSTALLATION:THE ABOVE PARTS (⧫) MUST BE REMOVED .

2. CLEAN MATING SURFACE (INPUT END) OF P–11611 P.T.O. HOUSING.

3. INSTALL 2–PM–4049A DOWEL PINS INTO MANIFOLD (AT MATING FACE NEAR REAR END OF PRIMARY SHAFT(FW'D.SHAFT). CHAMFERED END OF PINS SHOULD BOTTOM IN HOUSING HOLES.

4. INSTALL B3642 P.T.O. HOUSING GASKET OVER 2–PM–4049A DOWEL PINS AND ENSURE THAT THIS GASKET IS FLAT AGAINST THE MANIFOLD FACE.

5. INSTALL 2–A2711AU DOWEL PINS PROVIDED INTO REAR END OF PRIMARY SHAFT (FW'D SHAFT): CHAMFERED END OF PINS SHOULD BOTTOM IN SHAFT HOLES.

6. ATTACH AN AIR HOSE TO CLUTCH HOUSING(PX–11611) (HOLE IS TAPPED FOR M10X1.0(ISO–6149"O"–RING FITTING) TO DELIVER AND HOLD 89.6 KPA(13 PSI) MINIMUM TO CLUTCH DURING ASSEMBLY.

7. STAND P.T.O ON ITS FACE " E"(OUTPUT) END. LOOKING DOWN INTO CLUTCH PACK, ALIGN TEETH OF DRIVING PLATES BY EYE AND CAREFULLY SLIDE P–11601 DRIVING RING INTO P.T.O. HOUSING SO THAT IT ENGAGES THE TEETH OF ALL DRIVING PLATES AND BOTTOMS AGAINST THE INSIDE OF THE HOUSING.

8. APPLY AIR PRESSURE 89.6 KPA(13PSI) MIN. TO CLUTCH HOUSING(PX–11611) AND MAINTAIN PRESSURE,THIS LOCKS PLATES IN PROPER ALIGNMENT FOR ASSEMBLY. SLIDE DRIVING RING OUT OF P.T.O. HOUSING.

9. ASSEMBLE M1904AQ PISTON RING INTO GROOVE OF DRIVING (IF NOT ALREADY DONE).

10. ASSEMBLE DRIVING RING TO REAR END OF PRIMARY SHAFT(FW'D.SHAFT) BY SLIDING DRIVING RING ONTO DOWEL PINS AND PUSHING CAREFULLY FORWARD INTO SHAFT BORE AND AGAINST PRIMARY SHAFT(FW'D.SHAFT).FASTEN USING 2–PM–1180G SCREWS PROVIDED AND TORQUE PER S574 OR TO SERVICE MANUAL VALUES.

11. SLIDE P.T.O. ASSEMBLY,STILL AIR PRESSURIZED,CAREFULLY FORWARD OVER DRIVING RING SO THAT RING ENGAGES THE TEETH OF THE CLUTCH PLATES. P.T.O. ASS'Y. MAY NEED TO BE ROTATED SLIGHTLY IN EITHER DIRECTION TO ENGAGE THE PLATE TEETH. IF P.T.O. DOES NOT LINE UP WITH DOWEL PINS,ENGINE MUST BE HAND–TURNED UNTIL P.T.O. DOES LINE UP. DO NOT RELEASE AIR PRESSURE TO CLUTCH PACK. SECURE P.T.O. WITH 4–MA996–S CAP SCREWS, OR THE 4–PM–1369–Y STUDS AND 4–PM–1399J NUTS PROVIDED, AND TORQUE PER S574 OR TO SERVICE MANUAL VALUES.

12. AIR PRESSURE MAY NOW BE RELEASED. DISCONNECT AIR LINE AND FITTINGS FROM CLUTCH HOUSING(PX–11611).

13. ASSEMBLE BODY ASS'Y PX–11610 ON CLUTCH HOUSING,SECURE WITH 5–PM–3254B CAPSCREWS & TORQUE PER S–574A OR TO SERVICE MANUAL VALUES.

14. ASSEMBLE CLUTCH ENGAGING PRESSURE FITTINGS FROM THE BODY VALVE(PX–11610) TO THE CONTROL VALVE AND HEAT EXCHANGER.

SECTION : "B–B"

HYDRAULIC P.T.O. SHAFT DRIVE PX–11615

CONTROL VALVE

TWIN DISC ©

PRIMARY CLUTCH SHAFT ℄

SECONDARY CLUTCH SHAFT ℄

HYDRAULIC P.T.O. PUMP DRIVE PX–11615–A

FACE"E"

SAE#0

703.0 (27.68)

590.0 (23.23)

168.0 (6.61)

OUTLET TO FILTER (1)

INLET FROM H.E. (2)

INLET FROM EXTERNAL H.E. (NOT SUPPLIED)

OUTLET TO VALVE(2)

INLET TO FILTER(1)

WATER IN

WATER OUT

P.T.O. CLUTCH PRESSURE

PUMP SPLINE DATA
FLAT ROOT
14 TEETH
12/24 PITCH
30° PRESS.ANGLE
1.167" PITCH DIA.

24.0 (.94) (4 STUDS)

10.5 (.41)MAX.

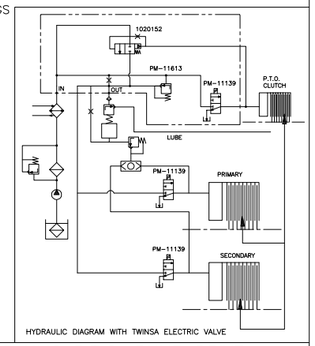
101.3 (3.99)

12.7x12.7x95.2 KEY. (.50x.50x3.75)

S.A.E. J744 SIZE" "C PUMP MOUNT: FOUR(4)M12x1.75 THREADED STUDS WITH NUTS,EQUALLY SPACED ON 161.92(6.375)DIA. (BASIC)H.C.

PTO. OIL DRAIN TO MARINE TRANSMISSION SUMP

PX11610	1				
P11610	1				
M1990C	2				
M1990E	1				
1020152	1				
MA1038–F	1				
PM–11139	1				
PM–3254H	1				
PM–3254B	4				
M2051BH	1				
MA–1038A	1				
PM–4360AB	1				
PM3533–BQ	1	*			
PM2523–N	2				
MA1053–D	2				
PM1349–AE	2				
PM11613	1				
PX–11602	1				
P–11602	1				
M1945BV	1				
M1945AJ	12				
M2078M	1				
M2033X	1				
MA983	1				
M2693J	1				
P–11612	1				
B3628	1				
MA996–S	4				
PM–2057Z	4				
XA2701BH	12				
A2701BH	1				
A2700AM	1				
B2506	12				
PM–11261A	1	**			
PM–2057–AJ	4				
PM–1357–B	4				
PM–2805G	1				
P–11607	1	●			
PM4330U	2	●	©		
M20141–A	1	●			
PM–11608	1	●			
A2903AU	1	●			
M1945T	1	●			
PM3533–AU	1	*			
PM–1180G	2				
A2711AU	2				
PM–4049A DOWEL PIN	2				
P–11611	1				
PM–1369Y	4	●			
PM–1399J	4	●			
PX–11581	1	●			
P–11581	1	●			
M1841AK	1	●			
M–2031–L	1	*			
M–2052–AJ	1	*			
M–2988–J	1	**			
*PM2261–D	1				
PM2261–D	1	*			
M2031–D	1	*			
PM–10864B	1				
A2012–A	1				
M422	2				
A2916–AJ	2				
B3642	1				
M1904AQ	1				
PM–11601	1				
B2510	1				
221774A	2				
2017932	8				
B3068B	7				
204097	1				
M2746BS	1				
B3643	1				
B6274B	1				
M2746CS	2				
PM–11609	1				
P–11607A	1				
A2916EJ	1				
PM4330U	2				



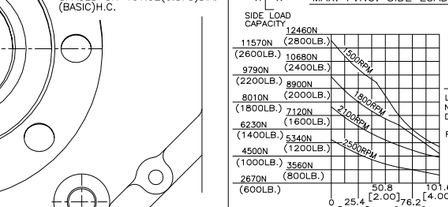
HYDRAULIC P.T.O. PUMP DRIVE SPECIFICATIONS:

HORSEPOWER RATING : 162HP AT 1800 R.P.M.
MAX.P.T.O. WORKING TORQUE : 641Nm(473 LB.FT.)
MAX.P.T.O. OPERATING SPEED : 2500 R.P.M.
RECOMMENDED MAX.ENGINE SPEED WHEN ENGAGING CLUTCH: .5x MATCH POINT SPEED.
P.T.O SHAFT ROTATION SAME AS ENGINE ROTATION.
P.T.O. CAN BE USED WITH R.H. OR L.H. ROTATION ENGINES.
P.T.O. ACCEPTS S.A.E. J744 SIZE" C" PUMP.

HYDRAULIC P.T.O. SHAFT DRIVE SPECIFICATIONS:

HORSEPOWER RATING : 162HP AT 1800 R.P.M.
MAX.P.T.O. WORKING TORQUE : 641Nm(473 LB.FT.)
MAX.P.T.O. OPERATING SPEED : 2500 R.P.M.
RECOMMENDED MAX.ENGINE SPEED WHEN ENGAGING CLUTCH: .5x MATCH POINT SPEED.
P.T.O SHAFT ROTATION SAME AS ENGINE ROTATION.
P.T.O. CAN BE USED WITH R.H. ROTATION ENGINES. ONLY.
BACKDRIVING OF P.T.O. IS NOT PERMITTED.
MAX.EXTERNAL THRUST LOAD ON P.T.O. SHAFT IN EITHER DIRECTION=.5xSIDE LOAD CAPACITY (WITH NO SIDE LOAD ON P.T.O. SHAFT)

" " MAX. P.T.O. SIDE LOAD :



THE FOLLOWING GENERAL FORMULA SHOULD BE USED FOR DETERMINING THE ACTUAL APPLIED LOAD:

(in LBS) L = 126,000xHP xF / NxD

(in N) L = 560.67xHP xF / NxD

WHERE :
L=ACTUAL APPLIED LOAD(N OR LBS)
N=SHAFT SPEED(RPM)
D=PITCH DIA.(mm OR in.) OF SHEAVE,ETC.
F=LOAD FACTOR
1.0 FOR CHAIN OR GEAR DRIVE.
1.5 FOR TIMING BELTS.
2.5 FOR ALL V BELTS.
3.5 FOR FLAT BELTS.
FOR RECIPROCATING COMPRESSORS AND OTHER SEVERE SHOCK DRIVES, MULTIPLY ABOVE FACTORS BY 2.1

OBSOLETE
FOR PRODUCTION AND SERVICE
REPLACED BY :PX12180JA
DATE : 19OCT04
TWIN DISC INTERNATIONAL S.A

METRIC

THIRD ANGLE PROJECTION

ASSEMBLY INSTRUCTIONS

▼ IMPORTANT :
IF CLUTCH STARTS TO TURN IN NEUTRAL AT OPERATING TEMPERATURE,BRAKE PLATE IS PROBABLY WORN. REPLACE IT AND SERVICE CLUTCH AS REQUIRED TO ELIMINATE TURNING IN NEUTRAL BEFORE FURTHER OPERATION.

UNMARKED PARTS COMMON TO BOTH DRIVE TYPE P.T.O'S.
○ DENOTES PARTS FOR SHAFT DRIVE HYDRAULIC P.T.O.(ONLY, PX–11615)
● DENOTES PARTS FOR PUMP DRIVE HYDRAULIC P.T.O.(ONLY, PX–11615–A)

IMPORTANT :
FOR INSTALLATIONS DRAWING WITH HEAT EXCHANGER SEE : PX–11380(SHEET 2) AND FOR OTHER DIMENSIONS SEE PX–11380 (SHEET 2)

NOTE :
ALL POINTS AVAILABLE FOR TESTING ARE CODED ⬡ .

*OPTION WITH HEAT EXCHANGER ON UNIT.
**OPTION LESS HEAT EXCHANGER ON UNIT.

SYM.	CH. NO.	DATE	SYM.	CH. NO.	DATE
D	7284	19OCT04			
C	6856	15APR03			
B	6819	20FEB03			
A	6537	31JAN02			

SIMILAR TO :
MATERIAL
WEIGHT kg / Nm
HEAT TREAT
FIRST USE
ASSEMBLY N° PX–11380
MODEL N° MG5135–A/SC
SURFACE TREATMENT
NAME POWER TAKE OFF ASS'Y.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS X.X ±0.25 X.XX ±0.13
ALL ANGULAR TOLERANCES ±1° GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982
DATE 13AUG01
SCALE 1/2
DRAWN RZ
CHECKED VR
APPROVED JCP
SHEET 1/1 REVISION : D FORMAT A1
TWIN DISC INCORPORATED RACINE, WI 53403 – USA
PX–11615;–A

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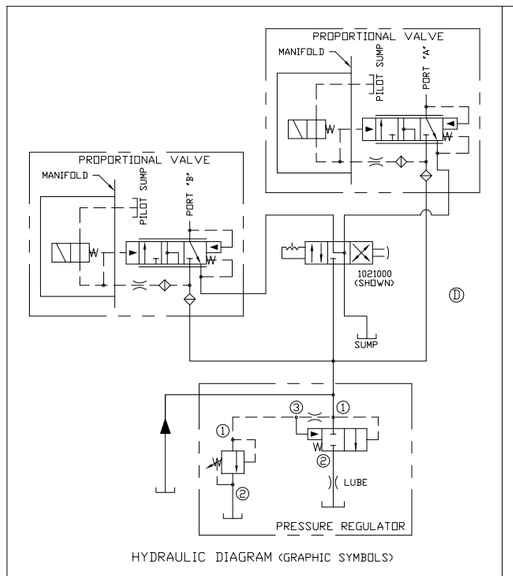
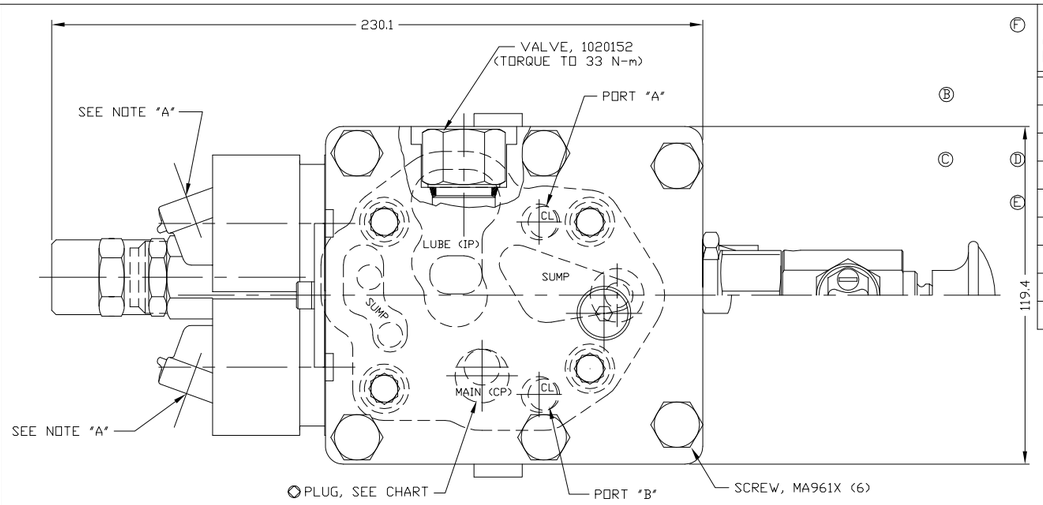
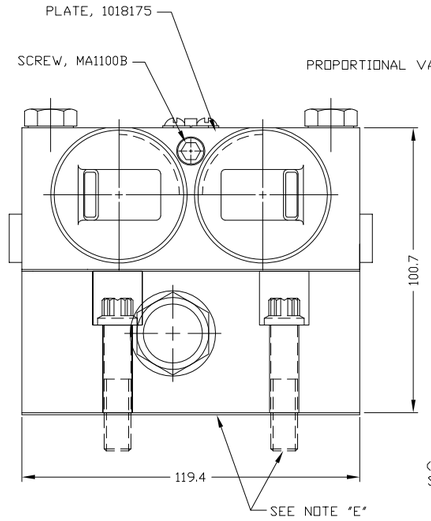
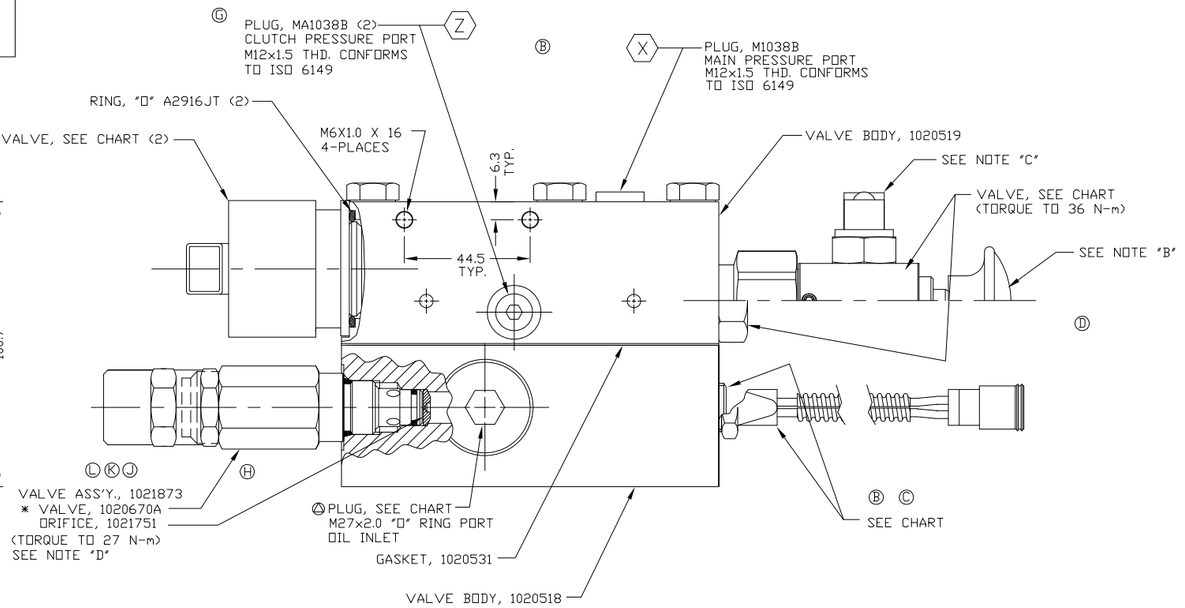


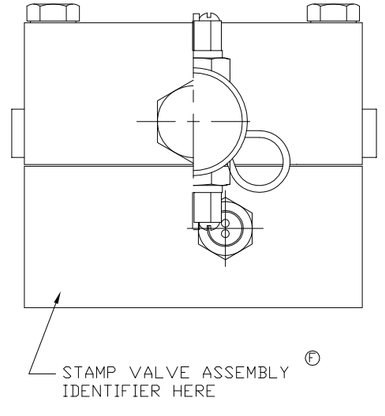
HYDRAULIC DIAGRAM (GRAPHIC SYMBOLS)



VALVE ASSEMBLY PART NO.	BOM	VALVE ASSEMBLY IDENTIFIER	VALVE Ⓛ	SENSOR	◇ PLUG	△ PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE (PSI)
1020729A	42223	A	1021000A	1016122A	NONE	MA1038E	NONE	1020520 (350)
1020729B	42426	B	1021000A	1016122A	NONE	MA1038E	NONE	1018528 (250)
1020729C	42127	C	1021000A	NONE	M2051S	MA1038E	NONE	1018528 (250)
1020729D	42126	D	1021000A	NONE	M2051S	MA1038E	NONE	1020520 (350)
1020729E	42516	E	1020542	NONE	M2051S	MA1038E	M1945E PORT "A"	1018528 (250)
1020729F	42974	F	1021000A	NONE	M2051S	MA11185A	NONE	1018528 (250)




PLUG, MA1038B (2) CLUTCH PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
Z
PLUG, M1038B MAIN PRESSURE PORT M12x1.5 THD. CONFORMS TO ISO 6149
X
RING, "O" A2916JT (2)
PROPORTIONAL VALVE, SEE CHART (2)
M6X1.0 X 16 4-PLACES
6.3 TYP.
VALVE BODY, 1020519
SEE NOTE "C"
VALVE, SEE CHART (TORQUE TO 36 N-m)
SEE NOTE "B"
44.5 TYP.
VALVE ASS'Y., 1021873
* VALVE, 1020670A
ORIFICE, 1021751
(TORQUE TO 27 N-m)
SEE NOTE "D"
PLUG, SEE CHART M27x2.0 "O" RING PORT OIL INLET
GASKET, 1020531
VALVE BODY, 1020518
SEE CHART



NOTES :

A. PROPORTIONAL CONTROL VALVE OPERATION
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTTERY/POWER SUPPLY VOLATAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A"
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B"

C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH
   1. SWITCHES ARE NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

Ⓑ

D. PRESSURE REGULATOR INITIAL ADJUSTMENT PROCEDURE
   1. WITH NO OIL FLOW TO VALVE, TURN ADJUSTMENT STEM OF THE 1020670A VALVE COUNTER-CLOCKWISE UNTIL REACHING POSITIVE STOP.
   2. WITH A MINIMUM OF 1 gpm, ALLOW OIL TO FLUSH PRESSURE RGEULATOR.
Ⓙ Ⓚ 3. AFTER FLUSHING, TURN ADJUSTMENT STEM OF THE 1020670A VALVE CLOCKWISE UNTIL REACHING REQURIED PRESSURE SPCIFIED IN MARINE TRANSMISSION PRODUCTION TEST SPECIFICATION.
   4. LOCK ADJUSTMENT STEM IN PLACE USING JAM NUT AND CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING GASKET AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

* NOT SERVICEABLE SEPARATELY

Ⓑ REVISED AND REDRAWN - SUPERSEDES 1020729 DATED 8-9-02

Ⓜ OBSOLETE: REPLACED BY 1021658 FOR PRODUCTION AND SERVICE

REV	SHEET	ZONE	CH. NO.	DATE	REV	SHEET	ZONE	CH. NO.	DATE
M		A2	ECN12561	7-28-04	F		B6	ECN11978	11-18-03
L		B6 E2	ECN12457	5-28-04	E		B6	ECN11761	8-14-03
K		E2	ECN12413	5-7-04	D			ECN11703	7-30-03
J		E2	ECN12314	3-24-04	C			ECN11529	5-2-03
H		E3	ECN12058	12-18-03	B			ECN11368	4-08-03
G		E4	ECN12015	12-03-03	A			ECN11321	1-30-03

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MATERIAL

HEAT TREAT

SURFACE TREATMENT

WEIGHT lbs | WR² N·m²

FIRST USE
ASSY.
MODEL MGX-5114A
NAME VALVE ASSEMBLY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE mm
MACHINED DIMENSIONS
X ±0.75
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ANSI Y14.5M 1982

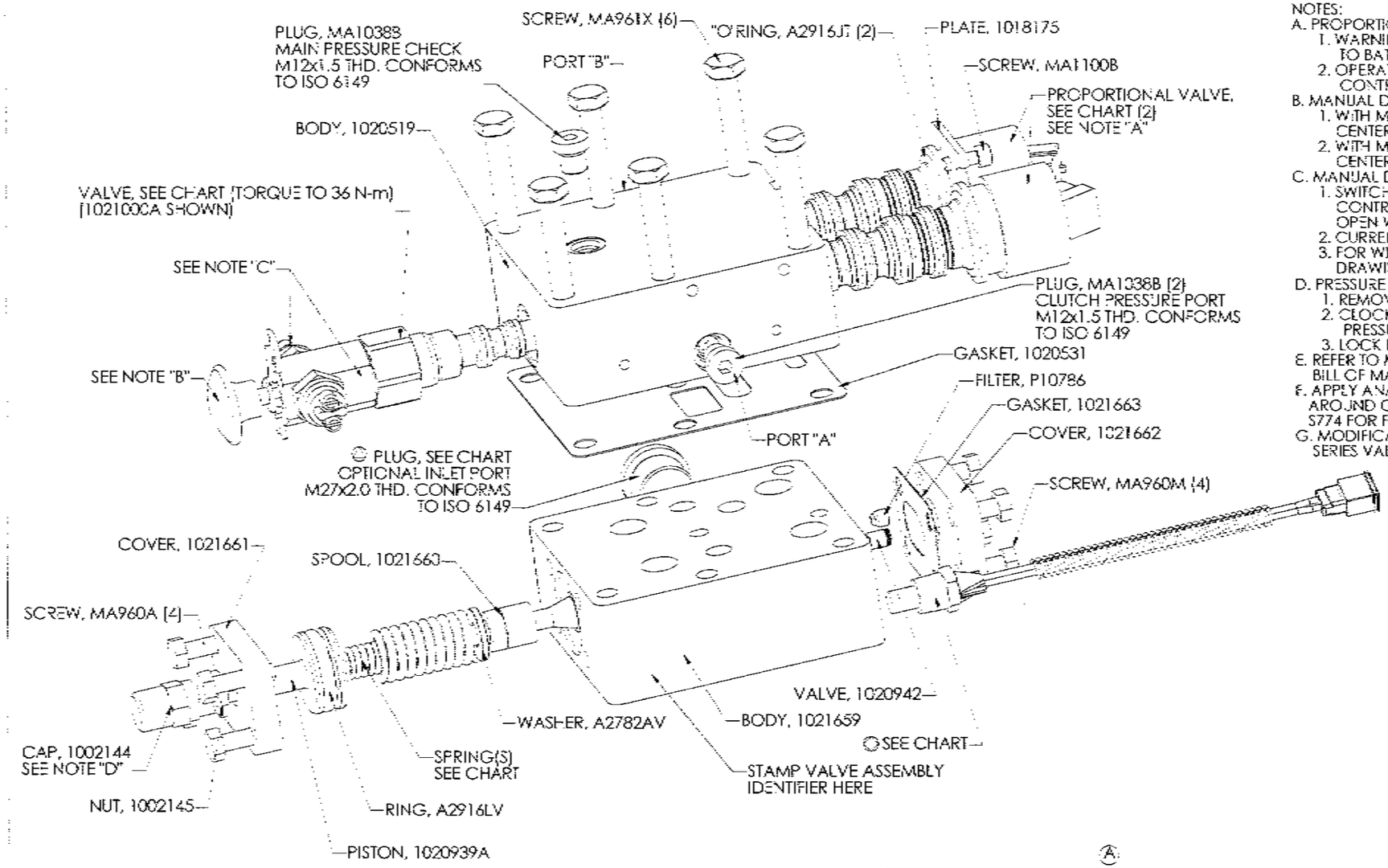
DATE 8-9-02
SCALE 1 : 1
DRN. D. MEYERS
CHK. ALC
APPD. GAM

METRIC
THIRD ANGLE PROJECTION
SIMILAR TO 1020525

TWIN DISC INCORPORATED RACINE, WI 53403 - USA

1020729 SERIES

SHEET 1 OF 1 REV M



NOTES:

A. PROPORTIONAL CONTROL VALVE OPERATION.
   1. WARNING DO NOT CONNECT VALVE COIL DIRECTLY TO BATTERY/POWER SUPPLY VOLTAGE.
   2. OPERATION TO BE PERFORMED WITH ONLY TWIN DISC CONTROL SYSTEMS OR MODULES.

B. MANUAL DIRECTIONAL CONTROL VALVE OPERATION.
   1. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PUSH TO ENGAGE PORT "A".
   2. WITH MANUAL DIRECTIONAL CONTROL VALVE IN CENTERED POSITION, PULL TO ENGAGE PORT "B".

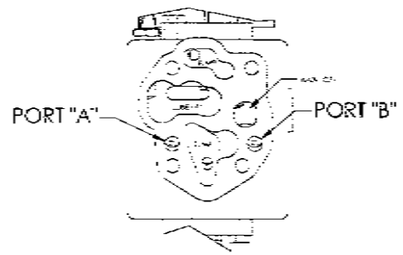
C. MANUAL DIRECTIONAL CONTROL VALVE MODE SWITCH.
   1. SWITCH IS NORMALLY CLOSED WHEN MANUAL DIRECTIONAL CONTROL VALVE IS IN THE CENTERED POSITION AND OPEN WHEN LEVER IS ACTUATED FROM CENTERED POSITION.
   2. CURRENT = 20 AMPS MAX.
   3. FOR WIRING SCHEMATIC, REFER TO CONTROL MODULE DRAWING.

D. PRESSURE REGULATOR ADJUSTMENT.
   1. REMOVE 1002144 CAP AND LOOSEN 1002145 NUT.
   2. CLOCKWISE ROTATION OF 1020939A PISTON INCREASES PRESSURE. COUNTER CLOCKWISE DECREASES PRESSURE.
   3. LOCK PISTON IN PLACE USING JAM NUT AND REPLACE CAP.

E. REFER TO MARINE TRANSMISSION ASSEMBLY DRAWING OR BILL OF MATERIAL FOR VALVE MOUNTING AND SCREWS.

F. APPLY ANAEROBIC SEALANT MEETING M2828 REQUIREMENTS AROUND CORE PLUG, JUST BEFORE FINAL ASSEMBLY. REFER TO S774 FOR FURTHER INFORMATION.

G. MODIFICATION KIT TO UPGRADE EXISTING 1020729/1020696 SERIES VALVE ASSEMBLIES TO 1021658 SERIES VALVE ASSEMBLY.



BOTTOM VIEW
SCALE = HALF

VALVE ASSEMBLY PART NO.	VALVE ASSEMBLY IDENTIFIER	BOM	PRESSURE kPa (psi)	SPRING(S)	VALVE	SENSOR	PLUG	PLUG	CORE PLUG SEE NOTE "F"	PROPORTIONAL VALVE	MODIFICATION KIT SEE NOTE "G"
1021658A	A	43190	1795-2205 (260-320)	20134120 20134120	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1417
1021658B	B	43111	1565-1795 (230-260)	20134120	1021000A	NONE	M2051S	MA1038E	NONE	1018528	K1418
1021658C	C	43112	2205-2760 (320-400)	20134120 20134120	1021000A	NONE	M2051S	MA1038E	NONE	1020520	K1420
1021658D	D	43195	1795-2205 (260-320)	20134120 20134120	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1417
1021658E	E	43196	1565-1795 (230-260)	20134120	1021000A	1016122A	NONE	MA1038E	NONE	1018528	K1418
1021658F	F	43197	2205-2760 (320-400)	20134120 20134120	1021000A	1016122A	NONE	MA1038E	NONE	1020520	K1420
1021658G	G	43198	1565-1795 (230-260)	20134120	1020542	NONE	M2051S	MA1038E	SEE NOTE "F"	1018528	K1419
1021658H	H	43199	1565-1795 (230-260)	20134120	1021000A	NONE	M2051S	MA1185A	NONE	1018528	K1418
1021658J	J	43200	1565-1795 (230-260)	20134120	1020542	NONE	M2051S	MA1053Q	NONE	1018528	K1418

REV	SHEET	ZONE	CHANGE	DATE
B			A2 :ECN12561: 7-28-04	
A			B3 :ECN12537: 9-28-04	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN MILLIMETERS
X ±0.5
X.X ±0.25
X.XX ±0.13
ALL ANGULAR TOLERANCES ±1°
GEOMETRIC TOLERANCING PER ASME Y14.5M-1994

DRAWN 1020891
MODEL MG-5222DC

METRIC

THIRD ANGLE PROJECTION

VALVE ASS'Y.

DATE 5-04-04
SCALE FULL
DRN D. MEYERS
CHK
APP'D
WTN DWG SIZE A1 SHT 1 OF REV B

TWIN DISC
INCORPORATED
RACINE WISCONSIN USA

1021658

#1022127 07/05

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